U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 130.

B. T. GALLOWAY, *Chief of Bureau.*

DRY-LAND AGRICULTURE.

PAPERS READ AT THE SECOND ANNUAL MEETING OF THE COOPERATIVE EXPERIMENT ASSOCIATION OF THE GREAT PLAINS AREA, HELD AT MANHATTAN, KANS., JUNE 26-27, 1907.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., June 8, 1908.

Sir: I have the honor to transmit herewith some papers on dry-land agriculture read at the second annual meeting of the Cooperative Experiment Association of the Great Plains Area, and to recommend their publication as a bulletin of the series of this Bureau.

The association mentioned is an organization made up of workers in the Department of Agriculture and in the State agricultural experiment stations who are cooperating in the agricultural development of the Great Plains. This organization has proved of great value in coordinating the various lines of work being conducted in the Great Plains and in bringing the men into closer and more sympathetic association. It is believed that the papers read at its meetings will prove of value to all interested in the agricultural development of this region. The membership of the association is confined entirely to Department and experiment station men, most of whom are either officials or collaborators of the Department of Agriculture.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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INTRODUCTORY STATEMENT.

While establishing the work in dry-land agriculture in the Great Plains area the need was recognized of bringing the widely-scattered station workers in the area together for the purpose of discussing and conferring with each other about the various lines of cooperative work to be carried on at these stations. A meeting was held in Washington, D. C., on November 15, 1905, for the purpose of considering the advisability of organizing an association which would bring into close relationship the officers of the Department of Agriculture and of the experiment stations who were carrying on cooperative work in dry-land agriculture in the Great Plains area.

The meeting was presided over by Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, and there were present either the presidents of the agricultural colleges or the directors of the agricultural experiment stations of the States lying within the area, as well as a number of Department men interested in the work.

An organization was effected and the title of "The Cooperative Experiment Association of the Great Plains Area" was adopted. The purpose of this organization, it was stated, "shall be to encourage and facilitate the coordination, systematization, and unification of all cooperative experimental work to be engaged in by the Bureau of Plant Industry and the experiment stations and substations of the several States included in whole or in part within the Great Plains area."

It was decided that meetings should be held at least twice each year—one of these to be held within the area—at which "papers shall be read, addresses delivered, and discussions carried on bearing directly upon the cooperative work of the Great Plains area." It was agreed that the directors and agriculturists of all States included in whole or in part within the Great Plains area and other members of the experiment stations' staffs engaged in cooperation with the De-

partment of Agriculture and all officers and members of the Bureau of Plant Industry who are interested and actively engaged in cooperative work in this area should be considered eligible for membership. Officers are to be elected annually.

The first annual meeting was held at Lincoln, Nebr., June 21–22, 1906, at which meeting a number of very interesting papers on important problems were read, but, owing to the fact that no arrangements had yet been made for the publication of papers by the association, they were published elsewhere.

The second annual meeting was held at Manhattan, Kans., June 26–27, 1907, with President E. A. Burnett in the chair. After an address of welcome by President E. R. Nicholls, of the Kansas Agricultural College, several papers were read and discussed. All are included in this bulletin, except one by Mr. T. H. Kearney, of the Department of Agriculture, upon "A striking example of dry-land arboriculture," describing the growing of the date palm in the Sahara; a paper by Prof. J. B. Nelson, superintendent of dry-farm work, Montana, upon "Dry farming in Montana;" and a paper by Dr. R. P. Hibbard, of the Department of Agriculture, upon "Soil bacteria."

E. C. Chilcott,
Agriculturist in Charge of Dry-Land Agriculture Investigations.

Washington, D. C., *May 26, 1908.*

THE DEVELOPMENT OF DRY-LAND FARMING.

By E. A. Burnett, *Director of the Nebraska Agricultural Experiment Station, Lincoln, Nebr.*

The development of agriculture in the semiarid regions of the Great Plains area is a question of national importance. It involves the settlement of a large area of fertile land, awaiting only the conservation of moisture sufficient to insure the growth of crops or the selection of varieties which can maintain themselves under conditions which are often favorable, but sometimes extremely unfavorable, to crop production. The conservation of moisture in the soil by tillage to make up for the lack of rainfall during the growing period, the selection of early-maturing and of drought-resistant crops, and the practice of crop rotation to maintain fertility and the proper physical conditions of the soil seem to me the great problems which must be worked out in order that crop production may be extended into the region which has hitherto been occupied largely for grazing purposes.

Moisture is the great problem. Much of this area receives sufficient rainfall each year to grow an abundant crop, provided all this water could be trapped where it falls and be used by the crop. The great problem is to trap the water, to absorb the rain as it falls and prevent its running off, to impound the water in the subsoil reservoir and reserve it for the use of the crop when it may be needed for the purpose.

In this region of scant rainfall the distribution of water is particularly uncertain, a large proportion of the precipitation falling as local showers, which may come at opportune times over a small area, but leave many sections of the country—in fact, the greater part—to depend for the success of the crop upon water which has fallen at some earlier date. Unless it is possible through the conservation of moisture in the soil to grow certain grain crops practically without precipitation during a period of their growth, grain production in this region will necessarily be uncertain and hazardous. Not only is the precipitation uncertain in this region, but it often falls greatly in excess of the amount needed for immediate use, in the form of violent local storms which are so clean-cut in their outline that one farm may receive an excess of water while the adjoining land is left

dry and thirsting for rain. Grass land where closely pastured loses much of the rainfall by run-off and evaporation. Land which is plowed and cultivated to keep the surface loose furnishes ideal conditions for the absorption of rain and also furnishes the best condition to prevent the escape of the water which has entered the soil.

It is unnecessary for me to discuss the method of conservation of soil moisture before this body. We recognize the fact that soil moisture can be stored by cultivation sufficiently to insure a crop the following year where crop production would be hazardous or impossible without this previous preparation. The extent to which moisture can be stored, the extent and kind of cultivation necessary, and the minimum rainfall under which crop production is possible, I leave for others to discuss. These questions still need more accurate and extensive investigation. Many thousand acres of land which will not grow a crop every year are now being farmed by this method. Where rainfall is nearly sufficient to produce a crop the summer fallow is not needed every alternate year. Possibly only a short period of tillage previous to the sowing of the crop is necessary, but it is essential that an abundance of moisture should be present, especially in the subsoil. We must not be deceived into the idea that it will always rain just at the right time. This is exactly the thing which does not happen. Enough water should be stored in the soil to make the crop sure. If rainfall is abundant you will still produce a crop. I believe the conservation of soil moisture to be the most important question in farming in the semiarid country.

Summer tillage does more than to store moisture. It encourages the accumulation of nitrates in the soil. It puts the land in the proper physical condition for the growth of the crop, so that at the time the crop is planted all the conditions are favorable for its immediate germination and growth.

The problem of preventing the blowing of the soil under this intensive method of cultivation is serious. The high evaporation of moisture from the soil in the western country is due largely to the high velocity of the wind. The cultivation necessary to store moisture and produce the perfect tilth required for the best growth of the crop favors both the blowing and washing of soils. Rolling lands can not long be cultivated under such methods without washing badly, and I know of no alternative but to seed these lands down to grass or keep them for a considerable portion of the time in sod. Fortunately, over most of this region alfalfa can be grown with considerable success—over much of it with very marked success—and, if it is possible to cultivate land in a rotation by which it shall be held in grass for three or four years in a seven or eight year rotation, much of the damage which would otherwise result from excessive washing and blowing can probably be overcome.

The selection of the soil will also help materially in preventing its loss by blowing. We have not yet reached the period when all the land in this western area must be cultivated. In fact, it is probable that only a small percentage of this land should be under plow, and that only gradually should we try to reclaim for the use of the grain farmer the country which has proven successful as cattle range. The hard, level lands may be used for cultivation, while the rougher and sandier portions of the country can be maintained as range. In this way we shall minimize or overcome the losses from blowing and soil washing.

The planting of trees, especially for wind-breaks, should not go without mention in this connection, as nothing will so permanently check the force of the wind as the growth of timber; but the production of forests requires a generation. The influence of wind-breaks on the velocity of the wind is but local, affecting the land for only a short distance away from the wind-break. Agriculture on a large scale must depend upon some other method of preventing the loss of soil than by foresting this great area of land which we seek to put under the plow.

The selection of varieties of crops suited to the dry region is also of prime importance in connection with this question. Certain principles should be worked out which apply to the general crops to be grown in this region. In this connection two important factors should be considered: (1) The selection of crops which can be grown and matured before the period of ordinary summer drought, and (2) the selection of those crops which can withstand a period of drought and continue their growth when sufficient moisture is later available.

In this connection it occurs to me that throughout a large portion of the Great Plains area winter wheat should be looked upon as a standard crop, and an effort should be made to determine the limits under which it may be successfully grown. It is true that the time when drought conditions will prevail can not be determined to a certainty. Winter drought is a common form. While spring rains are generally abundant, they are sometimes lacking until late spring or early summer. On the whole, however, I believe that winter wheat may be grown with little danger of winterkilling or of early spring drought if sufficient attention is given to tillage and the conservation of moisture previous to sowing the crop. Winter wheat possesses a decided advantage over the spring varieties—even over the durum wheats—which have been grown in Nebraska. It ripens considerably earlier and outyields the spring varieties. It is not greatly injured by early spring droughts when sown upon summer-tilled land. Under the conditions prevailing in Nebraska it has been possible to secure a good stand of winter wheat in the fall when lands not under summer tillage were too dry to germinate grain. In this connection it may be inter-

esting to state that light seeding—from one-half bushel to one bushel per acre—has yielded as well as heavier seedings. There seems to be little difference in the thickness of the grain at the ripening time between plats which had received one-half bushel of seed per acre and those which had received one bushel or more. This would indicate that in the ordinary heavy seeding only a portion of the grain ever occupies the ground, and that thick seeding at most does nothing more than prevent the tillering of the grain. It is presupposed in cases where light seeding is followed that the weeds have been killed so that they will not come on and occupy the ground before the grain has developed sufficiently to prevent their growth. The yields of winter wheat at the substation at North Platte in the year 1906 were as follows:

Turkish Red wheat, sown at the rate of 1¼ bushels per acre, yielded 42.13 bushels.

Turkish Red wheat, sown at the rate of 1 bushel per acre, yielded 44 bushels.

Turkish Red wheat, sown at the rate of ½ bushel per acre, yielded 42.3 bushels.

Kharkof wheat, sown at the rate of 1¼ bushels per acre, yielded 45.7 bushels.

The crop of winter wheat for 1907 at the North Platte substation promises to be as good as that harvested the previous year.

The durum wheats are now commonly grown throughout western Nebraska, and with quite satisfactory results. The area is annually extending into regions where wheat has not before been produced as a profitable crop. I am still of the opinion, however, that winter wheat will be more profitable than the durum wheat under the best methods of tillage, and that by this process the line of winter-wheat production can be pushed far into the dry country.

In the local tests of oats at the Nebraska substation, the early-ripening varieties have uniformly produced the largest and most satisfactory yields, later varieties being injured by drought and rust. Among these early and successful varieties may be mentioned the Kherson, the Sixty-Day, and the Texas Red.

Our ordinary local barley has proved superior to any of the introduced varieties and furnishes a large quantity of grain for local consumption.

While corn is a somewhat uncertain crop in the dry region, it is also one of the most adaptable to local conditions, and there is no question about the ability of the station worker to develop varieties of corn which will be suited to the localities in which they are grown. The question as to what extent the corn crop may prepare the land for a subsequent small-grain crop should be carefully studied. I am uncertain as to the degree of drought resistance which can be produced in the corn plant, but cultivation will largely overcome the effect of drought by accumulating moisture in the soil for the use of the plant during the latter part of its growing period.

It is probable that the Kafir corns will always be more drought-resistant than the Indian corn and that they will be used for grain production in the southern portion of the Great Plains area.

I shall hope to hear a discussion during this meeting of what can be accomplished in securing crops which can actually grow and mature with a smaller quantity of water than those crops now being grown in the humid regions. If it can be demonstrated that properly selected crops can grow and mature with certainty in the dry region, producing a ton of dry matter, either grain or forage, with smaller amounts of water than our ordinary crops, this will be one of the most successful methods of pushing settlement into the semi-arid region. The durum wheats, Kafir corn, and sorghum give some promise along this line. I believe, however, it should be the work of the members of this association to determine whether these so-called drought-resistant crops actually grow and mature with less water, or whether they simply have a greater power of endurance under drought conditions, enabling them to withstand somewhat longer or more severe conditions of drought than tenderer varieties of crops.

The river valleys of this area are noted for their production of alfalfa, perhaps the most wonderful forage crop of the region. Either with or without irrigation they furnish a very large amount of forage for the winter maintenance and the fattening of cattle and sheep. Alfalfa has already extended itself in a limited way to the drier lands of this region and has demonstrated its ability to grow under dry conditions when once thoroughly established. This association should endeavor to determine the most extreme conditions under which alfalfa can be profitably grown on the high table-lands of the region, as I believe it easily possible to extend the area under alfalfa in a way which shall very greatly increase the stock-carrying capacity of the country. The successful introduction of alfalfa removes the last difficulty in the production of pork and the development of the dairy industry, two extremely profitable lines of farming which have not been much developed in this region. Alfalfa seed production also promises to be an industry which can be made highly profitable on the cheap unirrigated lands where the rainfall reaches from 10 to 20 inches per annum.

The region under consideration has developed into a great stock-growing country. The conditions of past years have very largely driven the grain grower out and allowed the cattleman and sheep-man to remain. The stockman has remained because he has been able to adapt his industry to the natural conditions of the country. He has gathered what nature has produced. He has not, as a rule, expended money upon the growing of cultivated crops. His industry

has been reasonably sure, but it has produced only a small revenue per acre and has not been conducive to the general settlement of the country.

Still, the fact that the grain grower has been driven from the land by adverse conditions, often more than once from the same region, is an indication to us that the settlement of the semiarid region with farmers who depend upon grain production should be well considered. Experiment stations should not be used to exploit the country and to bring into these regions men who can not or will not practice successful methods of grain growing. Intensive methods of tillage require a large expenditure for farm machinery and motive power in order to cultivate a small area of land. The average settler has not the means with which to secure this equipment; neither has he the knowledge which will enable him to put it into successful operation. The settlement of this region will progress much more rapidly and more satisfactorily if the settlers already in the country can be induced to practice somewhat better methods and to determine the success of new varieties and of new methods under farm conditions before an attempt is made to bring settlers into the country whose success is dependent upon conditions which they can not meet.

It is a mistake to assume that the climate of this region is changing permanently—that the rainfall follows the plow. While it is true that the conservation of moisture leaves more available for the crop, we have had wet years and dry years, lean years and fat years, in this region since the records of its settlement are available. The cattleman profits less by the years of abundant rainfall than the man who is growing grain. He also suffers less during the periods of drought. Having invested little in labor, seed, and farm machinery, he risks little in times of adverse conditions. His grass cures upon the ground, and he winters his cattle upon the range with limited amounts of forage which he has stored for their protection during adverse weather conditions.

But people are not content to let the cattleman occupy this region unmolested. The pressure for settlement from outside regions is continuous. The high-priced lands of the rich arable country are driving the poor man to the region of cheaper lands. It is the province of the stations in this region to determine how this settler who has already occupied the land may succeed, how he may protect himself so as not to be driven out when adverse years come upon the country, and how he may help to develop this country into one which will support a larger population and give a more certain revenue to its people. The high-priced land of older sections has increased the price of land in the Great Plains area. The cattleman can no longer expect to hold 20 or 25 acres of land for a steer. It must be grown

on a much smaller area. This means that the question of forage and possibly of grains for the steer's maintenance must be studied by the cattleman himself or he will be driven from the country by the small farmer and rancher who will give more personal attention to his cattle, producing a small area of crops, but never forgetting that grass is the crop which has built up and developed the region.

The better land will be cultivated first. Probably not over 10 or 20 per cent of the land between the ninety-ninth and one hundred and fourth meridian should be under the plow. If grasses can be produced which will support more live stock than heretofore, these should gradually be introduced. Forage crops should be grown in as large areas as possible for use in wintering the live stock which is now in the country. The losses of the ranchman from the depletion of his herd in winter through starvation must be overcome. Good business sense does not permit that a man with 100 head of cattle, weighing 100,000 pounds in the fall, should permit these cattle to come through the winter with a loss of 15,000 pounds of flesh which he must regain by months of summer growth. If the steer must live off a smaller area of land it means he must reach a market weight at an earlier age. This means better feed, more continuous growth, and the use of forage instead of the open range in winter.

The experiment station worker can aid in this matter by determining the methods which will make crop production successful in this area, by determining the varieties of crops which can be produced with greatest certainty and at largest commercial profit, and by suggesting the evolution which must take place in the present farm methods in order that the settler may prosper and that homes may be built in the country upon a substantial basis.

SOME SOIL STUDIES IN DRY-LAND REGIONS.

By F. J. Alway, *Chemist, Nebraska Agricultural Experiment Station, Lincoln, Nebr.*

The soils and crops of which I shall speak to-day are those of the hard spring-wheat region of Saskatchewan, particularly those of the experimental farm at Indian Head and of the region westward to Moose Jaw, a district that has been settled, though rather sparsely, for some twenty years. I wish to speak of the conditions and crops in this district somewhat in detail, because it is, in so far as I am aware, the only part of the Great Plains area in which the so-called "dry farming" has been tried for a considerable length of time and in which it has been found to be an economic success. It is a mistake to imagine that the Great Plains region suddenly ends at the forty-ninth parallel. Strange as it may seem, this new country is able to furnish valuable data bearing on the subject that we have met to discuss. Indian Head has the only experimental farm in the Great Plains area whose records go back before the dry years of the nineties. While this northern farm may have advantages of temperature and possibly of soil not enjoyed by the greater portion of the Great Plains region, these advantages must be inconsiderable when compared with those of parts of North Dakota, and may be slight even when compared with parts of western Kansas and western Nebraska.

Before my first visit to Saskatchewan I had visited western Nebraska and western Kansas looking for evidences of successful "dry farming," and was, accordingly, somewhat familiar with the conditions of soil and vegetation of the central portion of the Great Plains area.

The extreme northern part of the Great Plains region is similar in appearance and vegetation to the prairies and plains of Nebraska and Kansas.

Very little study has been devoted to the chemical and physical properties of the soils of the northern portion of the Great Plains region, better known as the Canadian Northwest. In the few investigations that have been conducted there methods have been employed which are adapted to the humid climate of eastern Canada, but which are ill-suited to the conditions that have produced the prairies and plains.

The commonly accepted explanation of the large yields of small grains obtained in Saskatchewan is quite erroneous and has served to prevent the recognition of the value to the agricultural interests of the semiarid portions of the United States of the large amount of data contained in the annual reports of the Indian Head experimental farm, covering a period of almost twenty years. The climate of the portion of the Saskatchewan with which I will deal is distinguished from that of the prairie portions of the United States chiefly by its lower winter temperature, its slightly longer summer days, and its low precipitation, the rainfall occasionally amounting to less than 5 inches during the crop season. Both American and English authorities have advanced or accepted in explanation of the large yields of grain in that region the theory that the frost penetrates to a great depth during the winter and that during the summer months this furnishes a constant supply of moisture to the growing grain. This theory seems to be due to a confusion of the two meanings of the term "frost," as though the cold which entered the soil in the winter time changed there to frozen water. Sir William Crookes in his presidential address before the British Association for the Advancement of Science in 1908 chose as his subject "The wheat problem." In the course of his address he made the following statement:

The fertility of the Northwest Provinces of the Dominion of Canada is due to an exceptional and curious circumstance. In winter the ground freezes to a considerable depth. Wheat is sown in the spring, generally April, when the frozen ground has become thawed to a depth of 3 inches. Under the hot sun of the short summer the grain sprouts with surprising rapidity, partly because the grains are supplied with water from the thawing depths. The summer is too short to thaw the ground thoroughly, and gate posts and other dead wood extracted in the autumn are found still frozen at their lower ends.

Sir William had passed through Saskatchewan the preceding summer. Storer, in his text book on agriculture, as an illustration of how melting ice may serve as a useful store of moisture in certain situations and for certain crops, makes the following statement regarding Assiniboia, which is now southern Saskatchewan:

Even in late July some of the soil still holds the winter's frost at a depth of several feet below the surface. This underground layer of frozen earth is believed to explain the wonderful fertility of the soil, as the frost in gradually coming to the surface during the summer months creates a moisture which, meeting the warmth from above, forms a kind of natural hotbed. This moisture counteracts the scarcity of rain during the spring and summer and accounts for the grain being forced with such amazing rapidity after the late sowing.

Up to the present time this "frost" explanation seems to have passed without criticism.

I am convinced that the soil of the prairie and of the grain fields of Saskatchewan does not remain frozen throughout the summer at

any depth. The winter of 1903–4 was the coldest that had occurred in twelve years. The winter had been unusually severe, the spring was late, and the early part of the summer cool. During the second week in July, 1904, I made borings to a depth of 9 feet in the most exposed situations that I could find. There was no trace of frost, although the soil at a depth of 6 feet was distinctly chilly to the touch. Both above and below, it was decidedly warmer. In the first part of April, 1905, I made numerous borings until the auger had passed through the frozen soil. In the exposed gardens and fallows the frost had penetrated from 4½ to 5½ feet. On the stubble it had reached a depth of only 3½ feet. The subsoil of the prairie was so dry that I could not decide how far the ground was frozen. It is probable that the frost is all out of the ground by the 1st of July of every summer, unless it be on the edges of the forest country, where the drifting leaves serve to prevent the thawing of the soil.

The fertility of the soil is apparent to any one who visits the Province of Saskatchewan at the close of a favorable crop season. It is a well-recognized fact, however, that in regions where the normal precipitation is very small, abundant crops are produced even on very coarse sands in those seasons during which the rainfall is unusually heavy and well distributed. Evidence that the soil of southern Saskatchewan is characterized by the ability to produce a high average yield of wheat, oats, barley, and potatoes for many years in succession without the application of any fertilizers or even the growing of leguminous crops is furnished by the annual reports of the Indian Head experimental farm, which has been maintained by the Canadian government since 1888. Experimental farms are maintained by the same government at four other places—Nappan in Nova Scotia, Ottawa in Ontario, Agassiz in British Columbia, and Brandon in Manitoba. The first three represent humid climates with a heavy winter precipitation, while the farms at Brandon and Indian Head are in the region of very light winter precipitation. The climate at Brandon is very similar to that at Indian Head except that the precipitation is somewhat heavier and the summer temperature somewhat higher. Part of the Brandon experimental farm is on the upland and part in the valley of the Assiniboine River, the latter being subject to occasional inundations and also, probably, to more or less subirrigation. No distinction has been made in most of the reports of the farm regarding the data inadmissible in a study of the relation of crop yield to rainfall.

In illustration of the above-mentioned characteristics, the yield of the 12 best-adapted varieties of wheat, oats, barley, potatoes, etc., during a period of from four to nine years that they have been under

trial at the five Canadian farms, where the conditions of experiments are similar, are given in Table I.

TABLE I.—*Average yields of the best-adapted varieties of various crops at the five Canadian experimental farms.*[a]

Crop.	Number of varieties grown.	Averages for years 1895–1903. For the five farms.	For Ottawa farm.	For Nappan farm.	For Brandon farm.	For Indian Head farm.	For Agassiz farm.	Average at Indian Head in 1901.
Oats, bushels[b]	12	76.2	64.5	77.2	88.5	94.5	67.5	132.8
Barley, 2-rowed, bushels	6	45.5	45.3	45.1	46.0	56.2	43.3	60.0
Barley, 6-rowed, bushels	6	50.8	50.1	50.6	56.0	60.5	45.9	64.0
Wheat, spring, bushels	12	34.3	28.0	36.9	35.9	42.2	34.9	63.2
Peas, bushels	12	35.7	33.6	31.9	47.3	41.5	37.5	57.7
Maize, green, tons	6	19.4	23.1	18.8	19.6	14.6	22.9	25.2
Turnips, tons	6	31.5	34.2	39.9	25.1	22.3	39.7	37.5
Mangels, tons	6	31.7	39.1	38.0	31.1	22.6	34.3	29.3
Carrots, tons	6	22.0	30.7	22.3	14.3	12.2	31.1	12.6
Sugar beets, tons	1	24.5	28.8	27.2	19.4	11.2	17.0	27.7
Potatoes, bushels	12	377.9	399.2	387.0	395.3	433.6	371.0	620.5

[a] Some of the varieties in the averages have been under trial only four years, but most of them have been tested for nine years.
[b] Bushels of 34 pounds.

It will be seen that the average yield of wheat, oats, barley, and potatoes is higher at Indian Head than at the other four farms. The yields of the same crops in 1901 are given in illustration of the effect of an unusually favorable season at Indian Head. It is important to note that only in the case of peas, in addition to the four crops mentioned, does the Indian Head farm give heavy yields. The other crops included in the table, as well as hay, produce more heavily at each of the other four farms.

The soil of the Indian Head farm is typical of that of the greater portion of the spring-wheat region of Saskatchewan. The surface soil consists in some places of bowlder clay, and in others of a very heavy lacustral deposit that had formed in the bottom of a large shallow glacial lake. The lacustral clay was not found to exceed more than 3 feet in depth on the Indian Head farm, while at Moose Jaw it exceeded 9 feet in depth in all places where samples were taken. The lacustral clay was everywhere underlaid by bowlder clay. (See Table II.)

The chemical composition of the subsoil of the district gives every evidence of the aridity of the climate, the percentage of carbonates and soluble salts being very high.

The amount of carbonates in the surface soils is in all cases less than that in the subsoil. The subsoil, judged by the content of carbon dioxid, is of two distinct types, the one carrying from 7.5 to 12 per cent and the other from 1.25 to 4 per cent. These two types of subsoil differ in physical as well as in chemical properties. The first

bowlder clay carries stones and bowlders, while in the second, a clay of lacustral origin, only an occasional small stone is found. The former rapidly disintegrates in contact with water, from 1 to 3 hours' boiling being sufficient to reduce it to clean, single grains, as observed under the microscope, while the latter when treated with water breaks up into small aggregations which, when rubbed with a stirring rod, become like putty, and which require from 30 to 36 hours' boiling with water to completely resolve into their individual soil particles.

The till, or bowlder clay, possesses much lighter color, both in the wet and in the dry condition, than the lacustral clay. The dried lumps of the former can be crushed between the thumb and finger, while those of the latter can not. As is shown by the table of mechanical analyses, the till is much richer in sand and poorer in clay particles than the lacustral deposit; the proportion of silt in the two is about the same. The difference in appearance of the two types of soil when removed from fields in which a crop of grass or some cereal has just reached maturity is very marked, the till being brought to the surface by an augur in the form of powder, resembling wood ashes, while the other forms a more or less coherent mass of small aggregations. One of the most important and characteristic properties in which the two types differ is the hygroscopic coefficient of the subsoil. The surface soil, on account of the humus it contains, possesses a high coefficient, no matter to which type it belongs. In the case of the subsoils that of the till has a value between 3.9 and 6, and that of the lacustral clay lies between 10.3 and 14.7. A careful examination of the samples whose coefficient lay between 5.8 and 10.8 showed that they were mixtures of the two types.

TABLE II.—*Mechanical analyses of specimens of the two soil types at the experimental farm at Indian Head, Saskatchewan.*

Character of soil.	Bowlder clay.	Lacustral clay.
	Per cent.	*Per cent.*
Gravel, 2 to 1 mm	1.7	0.0
Coarse sand, 1 to 0.5 mm	5.2	0.01
Medium sand, 0.5 to 0.25 mm	5.6	0.01
Fine sand, 0.25 to 0.10 mm	14.1	2.2
Very fine sand, 0.10 to 0.05 mm	12.3	6.7
Coarse silt, 0.05 to 0.016 mm	16.2	19.0
Fine silt, 0.016 to 0.005 mm	19.5	22.6
Clay, less than 0.005 mm	26.1	48.2
Total	100.7	98.8

In most of the fields examined on the Indian Head experimental farm the surface soil seemed to consist of a mixture of the two types. This is probably due to a combination of three causes, viz, (1) high winds, which blow soil from the surface of one type over the surface of the other; (2) the action of the plow where the layer of the lacus-

tral clay is very shallow; (3) the work of burrowing animals which carry bowlder clay subsoil to the surface and deposit it upon the lacustral clay.

I made analyses of samples of soil taken from each of the first 6 feet of a field of 10 acres that had never been fertilized. The field had been in fallow in 1904, and in 1905 bore a crop of spring wheat yielding on an average per acre over 46 bushels. The samples were secured in November, 1905. The amount of nitrogen in the surface foot of soil was large, amounting to about one-fourth of 1 per cent. The percentage of potash was high, and that of phosphoric acid was fairly high at all depths. The percentage of calcium carbonate below the first foot was very high, varying from 15 to 20 per cent. While the chemical analysis indicates this to be a fertile soil, there is nothing in its chemical composition to explain the remarkable crop yields that have been obtained.

There can be no doubt as to the semiaridity of the climate of southern Saskatchewan when an examination is made of the records of the meteorological stations which have been maintained there for the past twenty-three years by the Canadian government. A station has been maintained on the Indian Head farm since 1890, in latitude 50° 28′ and longitude west 103° 40′. It is 1,924 feet above sea level.

TABLE III.—*Rainfall and snowfall at Indian Head, Saskatchewan, in inches.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total rainfall.	Total snowfall.	Total precipitation (10 inches snow = 1 inch rain).	Total rainfall of crop season.
1890	.....	.....	.....	0.51	0.80	4.48	3.01	2.16	1.05	1.37	.....	.....	15.40	.....	.....	10.09
1891	.....	.....	.....	.00	.97	6.19	3.84	2.14	.86	.03	.....	.....	14.03	.....	.....	13.14
1892	.....	.....	.....	.60	.82	2.59	1.09	.89	.93	1.40	.....	.....	6.92	.....	.....	5.10
1893	.....	.....	.....	.00	3.17	4.60	2.12	.12	.10	.90	.....	.....	11.01	.....	.....	[illegible].89
1894	.....	.....	.....	1.20	.30	.80	.57	1.03	.....	.....	.....	.....	3.90	.....	.....	2.87
1895	.....	.....	.....	.00	2.10	3.95	3.82	.60	1.60	.10	0.90	0.90	12.17	.....	.....	10.37
1896	.....	0.05	0.00	1.75	2.83	4.32	1.90	1.39	.60	.00	1.40	.15	11.19	.....	.....	10.23
1897	0.25	.50	.30	.00	.00	11.20	1.52	1.30	.20	.80	1.30	.00	13.45	27.5	16.20	12.74
1898	.40	.30	.60	1.05	.50	4.14	3.36	4.00	4.03	1.85	.40	.00	18.03	26.0	20.63	9.75
1899	.40	.00	1.00	.50	2.15	5.24	.40	.90	1.15	1.20	.30	.40	9.64	41.0	13.74	9.19
1900	.10	.55	.45	.27	.80	.65	1.73	4.85	3.81	.50	1.00	.80	12.21	32.5	15.46	3.45
1901	1.50	.35	.20	1.71	.87	5.63	5.82	.00	5.10	1.58	.00	.50	17.76	55.0	23.26	12.38
1902	.00	1.40	1.35	.87	3.87	4.96	.67	.57	.42	.00	.60	1.30	10.71	53.0	16.00	9.78
1903	.40	.10	.35	.16	4.08	1.29	4.23	4.16	1.26	.40	1.10	1.40	15.48	34.5	18.93	12.50
1904	.85	2.25	3.30	.54	1.94	2.76	3.81	1.17	1.79	.32	.38	1.00	11.92	81.8	20.05	8.74
1905	.25	.45	.91	.57	3.34	5.16	2.47	2.23	5.00	.54	.....	.....	19.31	.....	.....	12.49
Average	.41	.61	.84	.61	1.78	4.25	2.52	1.72	1.74	.73	.74	.64	12.69	.....	16.55	9.54
Lowest	.00	.00	.00	.00	.00	.65	.40	.00	.10	.00	.00	.00	3.90	26.0	.....	2.87
Highest	1.50	2.25	3.30	1.75	4.08	11.20	5.82	4.85	5.10	1.85	1.40	1.40	19.31	81.3	.....	13.14

In Table III the rainfall and snowfall at Indian Head are given in so far as these are available. There is no record of the rainfall

at this station prior to 1890, and the snowfall previous to 1895 was not recorded. The records of the neighboring stations of Regina and Qu'Appelle, dating from 1885, indicate that the climate from 1885 to 1890 was similar in character to that from 1890 to 1895. However, the precipitation records of these stations should not be used in seeking a relation between rainfall and crop yield at Indian Head. There may be enough difference in the rainfall at two different places 20 miles apart to account for a poor crop at one place and a good crop at the other. Accordingly, in the consideration of the crop yields at Indian Head I use only the data for the years beginning with 1890.

Practically the whole of the precipitation from November to March, inclusive, is in the form of snow. It seems improbable that the snow which falls between the time when the ground freezes in the autumn and the time when it melts in the spring has much influence on the relative yield of spring-sown cereal crops except in so far as it favors germination of the seed. The snowfall is regarded in the table as melted snow (10 inches of snow equals 1 inch of rain). Over half the rain falls during the months of June and July, and over three-fourths between the time of seeding and that of harvest. There is, however, great variation from year to year in the precipitation of any one month, as is shown in the last two lines of the table.

The heaviest rainfall of any crop season occurred in 1891, it being 13.14 inches, closely followed by that of the years 1897, 1901, 1903, and 1905, when it was between 12 and 13 inches. The lightest rainfalls occurred during the crop season of 1894 (2.87 inches), 1892 (5.10 inches), and 1900 (3.45 inches for crop season of wheat, 4.18 inches for that of oats, and 5.86 inches for that of barley). In 1892 and 1894 the rainfall of the crop season was the same for all three crops. The yields of field crops of wheat, oats, and barley, sown on fallow in these dry years, were as follows:

TABLE IV.—*Yields at Indian Head during the three dry years 1892, 1894, and 1900.*

Year.	Rainfall of crop season.	Wheat.		Oats.		Barley.	
	Inches.	*Bu.*	*lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
1892	5.10	29	9	42	..	45	9
1894	2.87	16	46	26	17	16	29
1900	3.45	15	43	55	..	35	24

The summers of 1894 and 1900 were characterized by high temperatures with hot winds. In the summer of 1894 the temperature often reached 95° to 100° F. In 1900 on June 21, 22, and 23 the thermome-

ter registered maximum temperatures of 101.5°, 106°, and 103°. From Table IV it will be seen that high temperatures are not uncommon at Indian Head. The instances of unusually heavy precipitation in April have been in the form of snow, and those in October in that of rain. Rains of such a torrential character as to cause a considerable run-off from level plowed fields have been rare, those of June, 1897, being probably the only ones during the past seventeen years. The precipitation of this summer was so unusual that I quote the following description from the annual report of the station:

In the season of 1897 less than 1 one-hundredth of an inch of rain fell between the 1st of April and the 14th of June. Seeding commenced on the 16th of April and continued without intermission until completed. High and continuous winds were prevalent during the last week in April, the whole of May, and from the 1st to the 15th of June. On June 14 0.6 inch of rain fell; on the following day within nine and one-half hours 6.6 inches fell. Twenty-seven hours after this downpour ceased a rain began, lasting two hours, during which 0.9 inch fell, making 10.6 inches within five days. The greater portion of this rain flowed over the land to the coulées, thence to the Qu'Appelle River. The rainfall amounted to 2.12 inches between June 17 and harvest, which began on August 12 for barley, August 16 for wheat, and August 26 for oats. This amount was distributed as follows: June 27 (0.6 inch), July 4 (0.5 inch), 5 (0.1 inch), 7 (0.15 inch), 8 (0.4 inch), 10 (0.2 inch), and 23 (0.17 inch). No rain fell during August previous to the 26th.

In Table V are given the mean monthly temperatures for both North Platte and Indian Head. The differences in the winter time are great, but those in the summer are very much smaller.

TABLE V.—*Average mean temperature at Indian Head, Saskatchewan, and at North Platte, Nebr.*

Month.	Indian Head.	North Platte.	Difference.
	°F.	°F.	°F.
January	4	20	16
February	5	25	20
March	17	35	18
April	41	49	8
May	54	58	4
June	65	68	3
July	68	74	6
August	66	71	5
September	58	62	4
October	42	50	8
November	22	35	13
December	12	27	15
Year	38	48	10

In Table VI we have the annual maximum and minimum temperatures at Indian Head. While the minimum temperature is very low, the maximum temperature is generally quite high, sometimes exceeding 100° F.

TABLE VI.—*Maximum and minimum temperatures at Indian Head, Saskatchewan, from 1890 to 1906, inclusive.*

Year.	Maximum.	Minimum.
	° *F.*	° *F.*
1890	95	−40
1891	85	−42
1892	98	−44
1893	100	−52
1894	100	−39
1895	95	−38
1896	96	−38
1897	92	−48
1898	99	−32
1899	95	−43
1900	106	−37
1901	94	−37
1902	90	−35
1903	92	−42
1904	92	−47
1905	88	−43
1906	99	−[illegible]8

In Table VII we have the mean monthly precipitation at Indian Head and at North Platte. The precipitation is similarly distributed, but is higher at North Platte.

TABLE VII.—*Average precipitation at Indian Head, Saskatchewan, and at North Platte, Nebr., from 1890 to 1906, inclusive.*

Month.	Indian Head.	North Platte.
	Inches.	*Inches.*
January	0.41	0.47
February	.61	.42
March	.84	.75
April	.61	2.17
May	1.78	2.70
June	4.25	3.42
July	2.52	2.74
August	1.72	2.42
September	1.74	1.28
October	.73	.98
November	.74	.85
December	.64	.57
Total	16.55	18.27

The Indian Head experimental farm consists of 682 acres. In 1882 a large farming company broke up 640 acres. From that time until the Canadian government took possession in 1888 the entire section was in crop each year. Mr. Mackay, a farmer living in the district since 1882, was placed in charge of it as superintendent and still continues in that position. In his annual report for 1889 he stated that experience had shown that there was only one successful way in which crops could be raised on the prairies of western Canada, and that was by the use of the summer fallow for the purpose of storing moisture:

In this portion of the territories, at least, every settler knows the importance of properly preparing his land. For several years after the country became

open for settlement everyone imagined that grain would grow, no matter how put in, but now the man is devoid of reason who thinks he is sure of a crop without any exertion on his part. It is true that we have had one year since 1882 that required little or no preparation to give a most abundant crop, but too many know how little was received in the remaining years by poor cultivation.

Our seasons point to only one way in which we can in all years expect to reap something. It is quite within the bounds of probability that some other and perhaps more successful method may be found, but at present I submit that fallowing the land is the best preparation to insure a crop. Fallowing land is not required in this country for the purpose of renovating it, as is the case with worn-out lands in the east, and it is a question yet unsettled how much or how little the fallows should be worked, but as we have only one wet season during the year, it is found beyond doubt that the land must be plowed the first time before this wet season is over if we expect to reap a crop the following year. This wet season comes during June or July, at a time when every farmer has little or nothing to do, and then this work should be done. Usually seeding is over by the 1st of May, and to have the best results the land for fallow should be plowed from 5 to 7 inches deep as soon after this as possible. Land plowed after July is of no use whatever, unless there is rain in August, which very seldom comes to any great extent. A good harrowing should succeed the plowing, and all weeds or volunteer grain should be kept down by successive cultivations.

Almost the same statements appear in Mr. Mackay's last annual report, that of 1905:

It is very gratifying to know that throughout the territories summer fallowing is rapidly becoming general. No matter where farming is carried on, the farmers realize that to be sure of a crop they must prepare a portion of their land the year before the crop is grown; and apart from the value of the stored moisture there is the inestimable advantage of keeping weeds from overrunning the farm. The true worth of properly prepared fallows has been clearly demonstrated in past years in every grain-growing district of Assiniboia.

As has been pointed out in my previous reports, early and thorough work on fallows is absolutely necessary to success.

The minister of agriculture of the Province of Saskatchewan has recently stated in a published address that successful wheat growing in Saskatchewan depends upon the intelligent use of the fallow:

If one is to attain the greatest success in the cultivation of wheat on the western prairie, there are at least three outstanding questions that demand intelligent study and prompt action, and these are soil moisture, good seed, and weeds.

Taking the average year and the average prairie, soil moisture is by far the most important question that should engage the active attention of the farmer. Because of this, bare summer fallowing is becoming, and, indeed, in many parts has already become, the very foundation upon which successful wheat culture is based and profitably carried on. True, there are many dissenters from this, but these are invariably from localities where the rainfall is more abundant and fall plowing has met with a good measure of success.

During the past twenty-five years there has not been sufficient moisture, taking one year with another, to grow a crop each consecutive year; hence the

necessity of stopping every third or fourth year and catching up, as it were, with the supply of moisture that can be stored up in the soil during a season of bare fallowing.

The practice of summer fallowing is usually associated in the popular mind with the restoration of fertility; but not so in the West. Conservation of soil moisture is the primary object of bare fallowing.

The crops that have been found to regularly reach maturity and to be well adapted to the climate are spring wheat, oats, barley, peas, flax, buckwheat, native grasses, brome-grass, potatoes, and field roots. Red and alsike clovers do well when partially protected by snow during the winter. Alfalfa in field lots has not as yet, on account of lack of inoculation, had a thorough trial. Winter wheat has usually been entirely destroyed by the alternate thawing and freezing during April. Early varieties of Indian corn do not usually mature seed, but they are far enough advanced before the advent of frost to make good ensilage.

The crop season at Indian Head may be considered to extend from the time that the soil is sufficiently thawed on the surface to permit of the use of drills or harrows until the grain sown in reasonable season is ripe. Frequently the wheat sown late is caught by frost. The earliest recorded date of the beginning of seeding at Indian Head is March 22, 1894, and the latest, with probably the exception of this year, May 7, 1901. The present year shows a very late beginning of seeding, the bulk of the wheat crop having been sown between May 15 and May 31. The earliest harvest on record, namely, that of oats, began July 25, 1894, and the latest, that of wheat, on September 4, 1891. The average date since 1889 of the beginning of harvest in the case of barley is August 17; of oats, August 20; and of wheat, August 21. The growth of cereals in Saskatchewan is not nearly so rapid, in comparison with that of other places, as is popularly believed. The average length of time from seeding until harvest for the four grain crops is greater at Indian Head than at Brandon, Ottawa, or Nappan in Nova Scotia, as shown in Table VIII.

TABLE VIII.—*Average length of time from seeding until harvest at different experimental farms in Canada.*

Location of farm.	Barley.	Oats.	Wheat.	Peas.
	Days.	*Days.*	*Days.*	*Days.*
Indian Head	98	110	127	116
Brandon	92	105	118	120
Ottawa	97	110	117	116
Nappan	93	109	114	111
Agassiz	106	118	118	122

The length of the day in the summer time is not so remarkably long, as is evident when it is remembered that London is farther

north than Indian Head. It is true that in the Peace and Slave river districts the night is short, but these are several hundred miles north of where wheat growing is as yet practiced on any considerable scale.

As the greater portion of the farm at Indian Head is used either in experimenting with different varieties of cereals, grasses, and legumes or for the production of seed of the best-adapted varieties for government distribution throughout the western provinces, each grain crop is usually followed by a year of clean cultivation, to destroy all weeds, grasses, and especially volunteer grain. The year of clean cultivation, termed summer fallow, consists of deep plowing in May or June, followed by three or four harrowings during the summer. In the ensuing spring grain is drilled into the soil without preliminary preparation. Corn and root crops are preceded by, but not followed by, fallow. When the soil has been cultivated long enough to cause it to drift during high winds, the land is seeded with bromegrass or western rye-grass, and after two or three years is treated like virgin prairie sod. When the year of fallow has been followed by more than two crops of grain in succession, the yield of the third and subsequent crops has usually been so much smaller than when the land has been fallowed every third year that the practice is considered unprofitable. In general, however, the farmers in Saskatchewan employ the fallow only every fourth or fifth year, and then carry it out so poorly that at the end of July, in 1904, very few properly worked fallows were to be seen in a journey of several hundred miles through the grain-producing country.

In Table IX is shown the yield of wheat, oats, and barley both on fallow and on stubble since 1889 at Indian Head.

TABLE IX.—*Yield per acre of cereal crops at Indian Head, Saskatchewan, on fallowed land and on stubble field.*

Year.	On fallow.			On stubble.			Excess due to fallowing.				Rainfall of previous autumn.
	Wheat.	Oats.	Barley.	Wheat.	Oats.	Barley.	Wheat.	Oats.	Barley.	Average.	
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Inches.*
1890	35.3	......	......	......	......	......	......	......	......	......	......
1891	49.2	83.6	47.1	......	......	......	......	......	......	......	......
1892	29.2	42.0	45.2	......	......	......	......	......	......	......	......
1893	36.1	77.0	46.8	27.9	63.2	40.4	29	22	16	22	3.22
1894	16.8	26.5	16.6	7.5	10.1	6.8	124	162	144	143	1.12
1895	41.3	104.6	55.1	28.1	37.6	31.7	47	178	74	100	1.03
1896	40.1	95.5	57.8	29.7	......	......	35	......	......	35	1.70
1897	30.9	66.8	49.0	25.3	......	......	22	......	......	22	.60
1898	29.1	82.7	41.8	......	......	......	......	......	......	......	2.30
1899	32.4	75.8	46.8	28.9	......	......	12	......	......	12	8.88
1900	15.7	55.0	35.5	5.4	10.4	7.6	191	429	365	329	2.35
1901	41.7	100.0	52.2	38.4	90.0	49.2	8	11	5	8	9.16
1902	33.4	76.0	58.2	25.5	43.6	25.5	31	74	128	111	6.68
1903	35.8	94.0	54.6	15.4	43.8	18.7	132	115	192	146	.42
1904	39.4	75.5	43.1	30.3	62.1	36.8	30	21	17	23	1.66
1905	40.0	90.9	63.3	23.3	47.4	43.5	72	92	46	70	2.01

In the case of several years there evidently was no wheat sown on stubble at the experimental farm. In general there is little differ-

ence between the average yield on all plats and that on the fields, the greater adaptability of the varieties sown as field crops compensating for the usual advantages enjoyed by the plat experiments, on which many varieties are sown that are ill adapted to the climate. You will notice that in all cases the high yields have been obtained from the fallows. The year 1905, while not giving the highest yields at Indian Head, was in many respects ideal, and the relation of the yield of wheat on stubble to that on fallow may be considered a normal one.

When the annual yields are compared with the precipitation of the corresponding crop season, it is to be seen that the yield of grain on fallow varies in general with the rainfall of the crop season, but shows a closer dependence upon the total available moisture, which I will speak of a little later. The greatest difference between the yields on fallow and on stubble is to be observed in the case of those seasons that have been preceded by a normally dry autumn. In the case of the two years 1898 and 1900, in which the rainfall following the ripening of crops amounted to approximately 9 inches, the yields of the following years, 1899 and 1901, were about the same on stubble as on fallow. The explanation of the disappearance of the difference between stubble and fallow when the season had been preceded by a wet autumn is the following: During the summer large quantities of nitrates are formed and are stored up within reach of the plant roots, in the case of the fallow fields, so that crops on fallow under normal conditions are supplied with a large quantity of nitrates and an abundance of moisture, while those on stubble have neither such a supply of nitrates nor much moisture. A heavy rainfall in autumn carries the nitrates in the fallow fields below the reach of the plant roots and at the same time charges the stubble fields with moisture, thus putting the stubble in a condition similar to that of the fallow as regards water and nitrates.

A very light rainfall during the months of July and August when the rainfall of May and June has been abundant causes a comparatively light yield of straw, together with a good yield of grain, as shown by Table X.

TABLE X.—*Average yield of the field lots of grain at Indian Head, Saskatchewan, in years in which the rainfall of July and August was light, 1892 to 1902, inclusive.*

Year.	Rainfall of April, May, June.	Rainfall from July 1 to harvest.	Yield.					
			Wheat.		Oats.		Barley.	
	Inches.	*Inches.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*	*Bu.*	*lbs.*
1892	4.01	1.98	29	12	42	16	46	32
1893	7.77	2.24	36	6	67	1	45	36
1896	8.90	3.29	36	35	96	27	59	31
1897	11.20	1.52	30	53	67	24	50	27
1899	7.89	1.80	32	27	76	26	48	15
1902	9.70	1.24	33	25	76	33	44	23

I have been unable to find any connection between the winter temperatures and the yields of the following season.

By far the most interesting results of my investigations are those dealing with the amount of moisture existing in what may be called an available form in the grass, fallow, and stubble fields, as determined foot by foot to a depth of 6 feet. In Table XI there is shown the number of tons of free water in each acre-foot of different fields at Indian Head and Moose Jaw.

TABLE XI.—*Available moisture in fallowed fields at Indian Head and Moose Jaw, Saskatchewan, compared with that in fields that have just brought a cereal or grass crop to maturity. The water is expressed as tons per acre-foot.*

Field.	Date.	First foot.	Second foot.	Third foot.	Fourth foot.	Fifth foot.	Sixth foot.	Total.
		Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
A	July 25, 1904	127	75	97	112	84	101	596
A	September 4, 1905	268	157	167	177	170	152	1,091
	Excess in second year	141	82	70	65	86	51	495
B	July 25, 1904	291	184	196	199	236	194	1,800
B	September 5, 1905	179	95	77	69	167	211	798
	Excess in fallow	112	89	119	130	69	17	502
D	July 25, 1904	350	272	279	216	144	....	1,261
D	September 5, 1905	270	158	144	97	182	....	734
	Excess in fallow	80	114	135	119	38	....	527
F	September 9, 1905	162	412	360	266	236	231	1,667
G	September 9, 1905	144	99	104	194	213	228	982
	Excess in fallow	18	313	256	72	23	3	685

The samples were obtained by the writer in July, 1904, and in September, 1905, a 1½-inch extension auger being used for the purpose. A large number of samples would have been desirable, but the difficulty of carrying on the investigations when the drying of the samples had to be done at a distance of over 1,000 miles from the fields limited the number of determinations. That the samples in which the water was determined were fair specimens of the various fields at the different depths was confirmed by the careful examination on the spot of the soil from similar depths in various parts of the fields. The samples are the average of the foot section from two or more holes in the same field, the soil being weighed as soon as removed and placed in light cotton sacks of known weight and later dried at 100° C. Duplicates of each sample were taken.

A whole series of samples was secured for me by Mr. Reynolds, accountant at the Indian Head farm, in November, 1904, just before the ground froze. It was hoped that these would yield valuable information as to the distribution of moisture in the subsoil at the beginning of winter. While the samples were being brought to an air-dry condition at Indian Head preparatory to shipping, they were so tampered with that many of them were rendered of no value. Accordingly the whole series has been omitted from consideration.

The distance to which the bare soil at the edges of the fields exerted an influence upon the crop was readily seen in the case of grass fields,

where the dark-green color and rank growth at the extreme edge stood in sharp contrast with the light-green color and weaker growth of the plants that were from 2 to 3 feet away. Through this short distance there was a gradual change in the appearance of the grass, but the plants farther in seemed to derive no benefit from the bare edges. In the case of each field all holes were bored at a distance of not less than 10 feet (usually more than 12) from the edge. Those from which samples for any one field were obtained were from 6 to 20 feet apart, it being necessary in most cases to make several borings before reaching the desired depth, the stones of the bowlder clay stopping the auger. In all the fields, while the depth to which the moisture from recent rains had penetrated varied somewhat, the succession of changes in the moisture content of the soil below the third foot was similar in all parts of the same field. In two fields of brome-grass all borings were stopped by stones within 3 feet of the surface.

Field A was seeded with western rye-grass (a native) in 1901, and has been cut for hay every year since, being mown about July 23, 1904, and July 13, 1905. No plants other than those of rye-grass were found within a distance of 3 feet of any of the holes. The growth of the grass in 1904 showed that it had suffered from an insufficient supply of water. Between the eighteenth and sixtieth inches the moisture content had probably been reduced to its minimum. From the sixtieth to the seventy-second inch the moisture content rose rapidly, the soil of the first 6 inches resembling wood ashes, while that of the last 6 inches was moist and sticky. In 1904 the rainfall between June 12 and July 1 amounted to only 0.39 inch. From the latter date until the samples were taken it amounted to 1.45 inches, occurring as follows: July 1, 0.1 inch; 12, 0.22 inch; 13, 0.93 inch; 16, 0.05 inch, and 17, 0.15 inch. The moist condition of the surface foot indicated that the water from the rain of July 13 was still largely retained at the time of sampling. No data are available to indicate to what extent the moisture content of the surface foot may be reduced by rye-grass. In 1905, between July 15 and the time of sampling, 4.26 inches of rain fell. Assuming that on the latter date the soil was as dry as on July 25, 1904, and that the weight of an acre-foot of dry soil is 3,348,000 pounds, the soil moisture available for rye-grass has been increased by 495 tons per acre when the rainfall amounted to 484 tons per acre.

Field B, which is just north of A, the two being separated by a roadway, had produced about 10 tons per acre of carrots in 1903 and was in fallow in 1904. In 1905 it bore a very heavy crop of oats (8,280 pounds of dry matter per acre). These had been cut a few days previous to the sampling. The straw, which was very heavy, had been badly lodged. At all depths in 1904 the soil was very

moist, but in 1905, while the recent rain of August 30 and 31 (1.28 inches) had moistened the soil to a depth of from 18 to 30 inches, the deeper portions of the subsoil resembled the subsoil of the rye-grass field in the preceding year. It was driest at a depth of 30 to 40 inches, gradually becoming moister from the fortieth to the sixtieth inch, and rapidly from the sixtieth to the seventy-second. As the recent rain had raised the moisture content of the first 2 feet, an allowance should be made in estimating the lowest limit of soil moisture permitting of the growth of oats. This may be safely placed at 18 per cent for the first foot. A pot experiment in which barley was grown in this surface soil showed that the plants wilted when the water content of the soil fell to 18 per cent. There was a difference of 502 tons of water per acre to a depth of 6 feet between the two dates of sampling, equivalent to 4.5 inches of rain. This probably represents the approximate storage capacity for water of this type of soil in the case of an oat crop.

Field C, which was about 300 yards south of A, had been in fallow in 1898, in wheat in 1899, in barley in 1900, in oats in 1901, in wheat in 1902, and in barley in 1903. It bore a crop of oats at the time of sampling in 1904. The crop, which at the time was in head, was very short in the straw and somewhat yellow in color, this field being selected for sampling because it showed the effects of the drought more than any other field bearing a cereal crop on the farm. The soil appeared about equally moist at all depths below the surface foot in 1904, while in the following year the moisture was lowest at a depth of from 30 to 42 inches, increasing gradually from the forty-second to the sixtieth inch and seeming uniform between the sixtieth and the seventy-second inch. The crop of wheat, which was in shock at the time of sampling in 1905, yielded, as determined later, 18 bushels and 24 pounds of grain and 1,056 pounds of straw to the acre.

Field D, which lay adjoining C on the south, had been alternately in wheat and in fallow since 1898, being in fallow in 1904 and in wheat in 1905. At the time of sampling in the latter year the crop was in shock. The soil was moist at all depths in 1904 and to a depth of about 2 feet in 1905. In the latter year, from the twenty-sixth to the forty-second inch it was very dry but became gradually moister from the latter depth to the sixtieth inch, the sixth foot seeming very uniform in moisture. The straw, which had not lodged, had been cut to leave a stubble from 8 to 10 inches long. The moisture in the upper 3 feet had evidently not been reduced to its minimum. As the soil of the field to this depth was in origin and character similar to that of field F, while the latter had not received so much rain during the later portion of the growing season, field F is

to be considered as better representing the lower limit of moisture for this type of soil. The soils from fields D and F to the depth of 3 feet are very similar in appearance and texture and have practically the same hygroscopic coefficient, viz, 13.0. Field D contained on July 25, 1904, within the first 5 feet of soil, 527 tons of water more than on September 5, 1905. The yield of this field for 1905 was 32 bushels and 46 pounds of grain and 3,724 pounds of straw.

Field E, 150 yards northwest of B, had been in fallow in 1904. At the time of sampling in 1905 the crop of wheat was in shock. It had lodged badly and the stubble had been left 10 to 12 inches long. The yield of grain was 15 bushels per acre and of straw 6,000 pounds per acre. The soil was moist to a depth of 18 inches on a very low ridge that traversed the field from north to south and to a depth of 24 to 36 inches at the foot of the ridge. At depths below the third foot no difference was observed between the moisture of the soil on the ridge and that in the depression. It was very dry to a depth of 42 inches, becoming gradually moister to the sixtieth inch, and seeming uniform throughout the sixth foot.

F and G were adjoining fields on the same farm, 1 mile south of Moose Jaw. These fields were selected because they promised to give the extremes of moisture, one being an unusually clean summer fallow and the other bearing a very heavy crop of wheat, which was in shock at the time. The soil was typical of a large plain of lacustral origin, the soil of which is very uniform over a great area, the underlying bowlder clay being exposed only in ravines. The uniform character of the soil is well illustrated by the hygroscopic coefficient of the twelve samples. These all lie between 11.4 and 11.8 for the third, fourth, fifth, and sixth foot sections, and a little higher for the first and second foot sections. The rainfall of 1904 at the Moose Jaw Meteorological Station, 1 mile distant, was 7.67 inches, and that of 1905 up to the time of sampling 13.03 inches. The precipitation of the latter year between July 30 and September 9 was only 0.78 inch, distributed as follows: August 1, 0.01 inch; 2, 0.28 inch; 3, 0.18 inch; 15, 0.01 inch; 26, 0.11 inch, and 28, 0.19 inch. With such a small rainfall during the last month of its growth it is probable that the heavy crop on field F, estimated at about 6,000 pounds per acre, had nearly exhausted the surface foot of available moisture before the light showers of August 26 and 28 fell. The fallow field G within the first 5 feet contained 682 tons per acre of free water (equal to 6 inches of rain) more than the adjoining field that had produced a crop. The wheat roots had not drawn as heavily upon the fourth and fifth feet as upon those above, nor had the season's rainfall been sufficiently conserved to raise to near its maximum limit the moisture content of the soil below the third foot in the case of the

fallow field. It should be noted, however, that the season of 1905 with an exceptionally well-distributed rainfall had not been favorable for the reduction of the soil moisture to its minimum, and that, further, the previous year had not had a sufficiently heavy rainfall to raise the moisture content of the first 4 feet to its maximum, even if surface evaporation had been entirely prevented. In the case of the fallow field about half the rainfall for the season had been stored, chiefly below the first foot. This amount of water would be sufficient to produce 20 bushels of wheat per acre if no surface evaporation took place and the ratio of grain to straw were 1 to 1.5. The writer determined the ratio of grain to straw (dried at 100° C. in each case) on field F, as well as on an adjoining field of wheat that had also produced wheat in 1904. The ratio of the grain to the straw was 1 to 1.35 on field F and 1 to 1.31 on the stubble field. The stubble, which was about 8 inches long on the latter and 12 inches on the stubble field, was about half as heavy as on field F. The whole crop on this farm consisted of 200 acres on fallow and 200 acres on stubble. The yield of the different fields was not determined, but that from the 400 acres was 12,000 bushels of wheat. The crop on fallow was very uniform, as was also that on stubble. The yields may be considered as 40 and 20 bushels per acre, respectively.

The calculation of the amounts of "available water" given in Table IX was based on the following asumptions:

(1) That the weight of an acre-foot of ground is 3,348,000 pounds.

(2) That the samples secured were representative of the different fields.

(3) That the available moisture is the difference between the total moisture content, as determined by drying at 100° C., and the maximum amount of hygroscopic water that is taken up by a soil when exposed to a saturated atmosphere. The latter, expressed as the hygroscopic coefficient (the amount of moisture held by 100 grams of dry soil, calculated as dried at 100° C.), was determined by Hilgard's method.

The first two assumptions may safely be considered as approximately correct; a difference of 10 to 15 tons of water per acre-foot may well be attributed to the lack of accuracy in the methods and in the assumptions. Differences of 50 to 100 tons of water per acre-foot can not justly be so explained. In the case of nearly all moisture determinations hitherto published the hygroscopic coefficient of the soil has not been determined, thus rendering the results of little value. Only the difference between the total water and the hygroscopic water (in a saturated atmosphere) is, even under the most favorable circumstances, available for plant growth. The hygroscopic water in air-dry soil is not a constant, as it depends both

upon the temperature and upon the humidity of the atmosphere with which it is in contact. The hygroscopic coefficient, on the other hand, is, according to Hilgard, a constant for a definite temperature, varying only by small fractions for temperatures between 7° and 23° C. It is also a critical point in relation to plant growth. Pfeffer states that "plants slowly die if the leaves are freely exposed while the roots and soil are kept in saturated air." If the leaves as well as the roots and soil are kept in a saturated atmosphere the plants live but make no growth. As all growth ceases and, except under the unusual circumstance of the air being saturated with water vapor, plants begin to die as soon as the point is reached at which the soil contains only its maximum amount of hygroscopic water, there is no possibility of any hygroscopic water being used for the growth of the plants. Very few data are available showing how near to the hygroscopic moisture the water content of a soil may be reduced by growing plants. Only under very favorable atmospheric conditions can a plant continue its normal development after the water content is reduced to near the hygroscopic coefficient.

As illustrations of how little value determinations of the total water content of soils usually have when the hygroscopic coefficient is not determined, the data in Tables XII to XVIII are presented:

TABLE XII.—*Amount of total moisture in different fields expressed as percentage of dry soil.*

Depth.	Field A.		Field B.		Field C.		Field D.		Field E.	Field F.	Field G.
	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	Sept. 5, 1905.	Sept. 9, 1905.	Sept. 9, 1905.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
First foot..	19.0	25.9	29.4	22.4	20.0	28.8	34.4	28.9	26.4	22.2	23.6
Second foot	14.8	20.3	14.9	16.7	22.4	19.8	29.7	22.7	14.8	18.6	36.8
Third foot.	13.9	20.9	16.4	9.2	21.6	10.9	29.5	20.9	15.4	18.0	33.2
Fourth foot	13.6	15.4	17.4	9.6	16.1	17.1	20.3	11.3	13.2	23.5	27.7
Fifth foot..	12.0	15.1	21.8	14.4	15.1	18.4	15.2	16.4	15.6	24.4	26.0
Sixth foot.	15.4	13.6	19.6	17.8	15.9	19.0	19.2	19.2	21.8	25.0	25.2
Average.	14.8	18.5	19.9	15.0	18.5	19.0	24.7	19.9	17.9	21.9	28.7

TABLE XIII.—*Relations of total moisture in first 6 feet of soil to the treatment the field had received.*

Field.	Date.	Water.	Treatment of the field.
		Per cent	
G......	September 9, 1905.....	28.7	Fallow 1905; wheat 1904; wheat or oats 1903.
D......	July 25, 1904..........	24.7	Fallow 1904; alternately in wheat and fallow since 1898.
F......	September 9, 1905.....	21.9	Wheat 1905; fallow 1904; wheat or oats 1903 and 1902.
B......	July 25, 1904..........	19.9	Fallow 1904; carrots 1903; fallow 1902.
D......	September 5, 1905.....	19.9	Wheat 1905; alternately in wheat and fallow since 1898.
C......	.....do................	19.0	Wheat 1905; oats 1904; barley 1903; wheat 1902; oats 1901; barley 1900; wheat 1899; fallow 1898.
C......	July 25, 1904..........	18.5	Oats 1904; see above.
A......	September 4, 1905.....	18.5	Rye-grass since 1901; cut for hay July 13, 1905; very little growth after mowing.
E......	September 5, 1905.....	17.9	Wheat 1905; fallow 1904.
B......	.....do................	15.0	Oats 1905; fallow 1904; carrots 1903; fallow 1902.
A......	July 25, 1904..........	14.8	Rye-grass since 1901; cut for hay July 23, 1904.

TABLE XIV.—*Field notes on condition of soil at time of sampling.*

Depth.	Field A.		Field B.		Field C.	
	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.
First foot	Moist	Very moist.	Very moist.	Moist	Dry	Very moist.
Second foot	Dry	Moist	Very moist.	Moist,[a] dry[b]	Moist	Moist.
Third foot	Powder	Moist	Moist	Powder	Moist	Powder.
Fourth foot	Powder	Moist	Moist	Powder	Moist	Powder,[a] moist.[b]
Fifth foot	Powder,[a] very dry.[b]	Moist	Moist	Moist	Moist	Moist.
Sixth foot	Powder,[a] moist.[b]	Moist	Moist	Moist	Moist	Very moist.

Depth.	Field D.		Field E, Sept. 5, 1905.	Field F, Sept. 9, 1905.	Field G, Sept. 9, 1905.
	July 25, 1904.	Sept. 5, 1905.			
First foot	Very moist	Moist	Very moist	Moist	Moist.
Second foot	Very moist	Moist	Moist	Dry	Very moist.
Third foot	Very moist	Dry	Powder	Dry	Very moist.
Fourth foot	Moist	Powder	Powder	Moist	Moist.
Fifth foot	Moist	Moist	Moist	Moist	Moist.
Sixth foot	Moist	Very moist	Moist	Moist	Moist.

[a] Above. [b] Below.

TABLE XV.—*Hygroscopic coefficient of different samples.*

Depth.	Field A.		Field B.		Field C.		Field D.		Field E,	Field F,	Field G,
	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	Sept. 5, 1905.	Sept. 9, 1905.	Sept. 9, 1905.
First foot	11.4	9.9	12.0	11.7	12.7	10.9	13.5	12.8	9.5	13.6	13.9
Second foot	10.3	10.9	3.9	11.0	13.2	9.7	13.5	13.1	6.9	12.7	12.2
Third foot	8.1	10.9	4.7	4.6	13.5	4.8	12.9	12.3	5.8	11.8	11.7
Fourth foot	6.9	4.7	5.5	4.5	4.6	5.4	7.4	5.5	5.8	11.9	11.8
Fifth foot	7.0	4.9	7.6	4.4	4.2	5.5	6.6	5.5	5.6	11.7	11.9
Sixth foot	8.9	4.5	8.0	5.2	5.9	4.4	6.6	6.6	10.0	11.4	11.4
Average	8.8	7.6	7.0	6.9	9.0	6.8	10.1	9.3	7.2	12.2	12.1

TABLE XVI.—*Amount of free moisture in different fields, expressed as percentage of dry soil.*

Depth.	Field A.		Field B.		Field C.		Field D.		Field E.	Field F,	Field G,
	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	Sept. 5, 1905.	Sept. 9, 1905.	Sept. 9, 1905.
First foot	7.6	16.0	17.4	10.7	7.3	17.9	20.9	16.1	16.9	8.6	9.7
Second foot	4.5	9.4	11.0	5.7	9.2	10.1	16.2	9.6	7.9	5.9	24.6
Third foot	5.8	10.0	11.7	4.6	8.1	6.1	16.6	8.6	9.6	6.2	21.5
Fourth foot	6.7	10.7	11.9	4.1	11.5	11.7	12.9	5.8	7.4	11.6	15.9
Fifth foot	5.0	10.2	14.2	10.0	10.9	12.9	8.6	10.9	10.0	12.7	14.1
Sixth foot	6.5	9.1	11.6	12.6	10.0	14.6	12.6	12.6	11.8	13.6	13.8
Average	6.0	10.9	13.0	8.0	9.5	12.2	14.6	10.6	10.6	9.8	16.6

TABLE XVII.—*Relation of free moisture in first 6 feet of soil to the treatment the field had received.*

Field.	Date.	Water.	Treatment of field.
		Per cent.	
G......	September 9, 1905.....	16.6	Fallow 1905; wheat 1904; wheat or oats 1903.
D......	July 25, 1904...........	14.6	Fallow 1904; alternately in wheat and fallow since 1898.
B......	.....do..................	13.0	Fallow 1904; carrots 1903; fallow 1902.
C......	September 5, 1905.....	12.2	Wheat 1905; oats 1904; barley 1903; wheat 1902; oats 1901; barley 1900; wheat 1899; fallow 1898.
A......	September 4, 1905.....	10.9	Rye-grass since 1901; cut for hay July 13, 1905.
D......	September 5, 1905.....	10.6	Wheat 1905; alternately in wheat and fallow since 1898.
E......	.....do..................	10.6	Wheat 1905; fallow 1904.
F......	September 9, 1905.....	9.8	Wheat 1905; fallow 1904; wheat or oats 1903 and 1902.
C......	July 25, 1904...........	9.5	Oats 1904; barley 1903; wheat 1902; oats 1901; barley 1900; wheat 1899; fallow 1898.
B......	September 5, 1905.....	8.0	Oats 1905; fallow 1904; carrots 1903; fallow 1902.
A......	July 25, 1904...........	6.0	Rye-grass since 1901; mown July 28, 1904.

TABLE XVIII.—*Amount of water in different fields that is probably available for the support of normal plant growth expressed as percentage of dry soil.*

Depth.	Field A.		Field B.		Field C.		Field D.		Field E,	Field F,	Field G,
	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 4, 1905.	July 25, 1904.	Sept. 5, 1905.	July 25, 1904.	Sept. 5, 1905.	Sept. 5, 1905.	Sept. 9, 1905.	Sept. 9, 1905.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
First foot..	1.6	10.0	11.4	4.7	1.3	11.9	14.9	10.1	10.9	2.6	3.7
Second foot	.0	3.4	6.5	.0	3.2	4.1	10.2	3.6	3.8	.0	18.6
Third foot.	1.3	4.0	7.2	.1	2.1	1.6	10.6	2.6	5.1	.2	15.5
Fourth foot	2.2	6.2	7.4	.0	7.0	7.2	8.5	1.3	2.9	5.6	9.9
Fifth foot..	.5	5.7	9.7	5.5	6.4	7.4	4.1	6.4	5.5	6.7	8.1
Sixth foot.	2.0	6.4	7.1	8.1	5.5	10.1	8.1	8.1	7.3	7.6	7.8
Average.	1.8	6.0	8.2	3.1	4.2	7.0	9.4	5.3	5.8	3.8	10.6

In Table XII the total moisture content is given. The average percentage of total moisture in the first 6 feet of field F, which had produced a very heavy crop of straw and grain with a total rainfall of 13 inches, of which less than 0.8 inch had fallen during the last five weeks of its growth, was 21.9, while that in the fallow field B (1904), which had had two years in which to store moisture, was only 19.9. From the determination of total moisture shown, it would appear that field F, with its 21.9 per cent of water, was in better condition for seeding than field B, with its 19.9 per cent. In reality, however, field B was in excellent condition, while field F was practically exhausted of all moisture that could be used by a growing cereal. In Table XIII the fields are arranged in the order of their average moisture content, so as to show what relation this bears to their previous treatment. The sample of the sixth foot section from field D in 1904 was lost before the moisture was determined. To make results comparable, I have assumed in the tables that the moisture was the same as at the same depth in the same field in 1905. The stubble field D (1905) had the same percentage of total moisture as the fallow field B (1904) on the same farm. The field C, which had been continu-

ously cropped with cereals since 1899, had almost as much water—19 per cent in 1905 and 18.5 per cent in 1904—as the fallow field B (1904). Yet fields B, C, and D were on the same farm and B is only a few hundred yards from C and D.

That the actual determination of total moisture gives less idea of the moisture conditions of different fields than a day laborer with a 6-foot auger could obtain is evident from Table XIV, which gives my field notes on the condition of the soil at the time the samples were secured. The terms "moist" and "very moist" need no comment. The samples adhering to the auger, but not moist, are called simply "dry." Those samples designated as "powder" resembled wood ashes and barely held to the auger when the latter was carefully removed from the bore. Those that formed "very dry powder" did not adhere to the auger and were removed only with great difficulty.

Table XV gives the hygroscopic coefficient of all the samples and Table XVI the free moisture of all. Table XVII shows the relation of the average free moisture of the first 6 feet to the treatment that the different fields had received. From this it is apparent that the percentage of free water in the fallows compared with that in stubble fields explains the difference in yield. The very low percentage of moisture in the rye-grass field is due to the practically complete exhaustion of available moisture from the fifth foot and the upper half of the sixth foot. The roots of the rye-grass reached to the middle of the sixth foot, while those of the wheat and oats grown on fallows evidently ended at depths between 4 and 5 feet. In Table XVI field C occupies an anomalous position, showing a higher average per cent of free moisture on September 5, 1905, than on July 25, 1904. Evidently crops on stubble under normal climatic conditions are not able to draw as much water from the lower 3 feet as those on fallows.

While the use of the hygroscopic coefficient in calculating the amount of free water enables us to form an idea of the difference in the amounts of available water held by different soils, it does not indicate the amount that is available in such form that the plant can continue a normal growth. It is probable that the water in the second to the fifth foot of the rye-grass field A (1904) and that in the second to the fourth foot of the oat field B in 1905, or in the first 3 feet of the wheat field F in 1905, would not have supported a growth of the cereals. It is probable that the normal growth ceases when the percentage of free moisture falls to from 4 to 8 per cent, according to the soil. Barley plants were grown for 6 weeks in a glass cylinder 10 inches deep filled with surface soil from Indian Head. At the end of this time water was withheld. When the barley plant died the soil at all depths below 2 inches contained 18 to 19 per cent of water. The hygroscopic coefficient was 12. Assuming that the minimum for soils

of low hygroscopic coefficient is 4.5 per cent and for those of high hygroscopic coefficient is 6 per cent, Table XVIII has been prepared to show the amount of water available for normal growth. This is merely to suggest the desirability of trying to arrive at the minimum to which the moisture in a given soil may be reduced without impairing the health of the plant. It may differ much for different plants and at different stages in the growth of the same plant. As Hilgard and Loughridge have shown, it certainly differs much for different soils.

On the basis of the above determinations it seems safe to estimate that in the case of bowlder-clay soils as much as 500 tons of available water may be stored, while in clay soils of lacustral origin the amount may be much more. In neither case is the surface foot included, as the latter is liable to lose a large part of its water through surface evaporation at a time when the plants are too small to draw heavily upon its moisture. Further, the storage capacity of the soil below the reach of the roots of the plants in question is not included.

The soil of the Indian Head farm is much more pervious to water and has a smaller water capacity than the Moose Jaw soil. It will accordingly become saturated and allow water to pass into the soil below the fifth or sixth foot more readily than the latter. This would explain why as heavy crops have been obtained at Indian Head after corn, potatoes, and field roots as on fallow, these crops not using the whole of the ordinary seasonal rainfall and they being sown on soil fully stored with water. In view of the ordinary rainfall, the methods of cultivation, the system of cropping, and the nature of the subsoil, the large crop yields obtained at the experimental farm are to be considered as those from fields that were supplied with not only the rainfall of the crop season, but also with a large part of that of the preceding season. The stored water is much more valuable than an equal amount of rain falling during the crop season, not only because it contains a large part of the nitrates formed during the preceding summer and because it increases the supply of potash and phosphoric acid by enabling the roots to penetrate more deeply, but also because it is largely secure from surface evaporation.

The total available water of the crop season in the case of crops on fallow fields, to which, as I have mentioned, the yield of total dry matter of the crops at Indian Head has been roughly proportional, I calculated by adding 5 inches to the rainfall of the crop season.

Professor Shutt, of the Canadian experimental farm, has well shown the failure of experiments which take into consideration only the first 16 inches of soil to account for the extremely favorable influence of the fallow year. He determined the amount of water in two fields on the Indian Head experimental farm once a month from

the beginning of the season to the end. His results are given in Table XIX.

TABLE XIX.—*Difference in the moisture content of cropped and of fallowed soil at Indian Head in 1900, to a depth of 16 inches.*

Date of sampling.	Rainfall from first of season to date of collection.	Water in Field S A (in fallow 1900, in crop 1899).				Water in field S B (in crop 1900, in fallow 1899).				Water per acre to a depth of 18 inches.		Excess of water in field in fallow, 1900.
		1 to 8 inches.		8 to 16 inches.		1 to 8 inches.		8 to 16 inches.				
		Per cent of moist soil.	Tons per acre.	Per cent of moist soil.	Tons per acre.	Per cent of moist soil.	Tons per acre.	Per cent of moist soil.	Tons per acre.	Field in fallow, 1900.	Field in crop, 1900.	
	Inches.									*Tons.*	*Tons.*	*Tons.*
May 8	0.27	22.03	264	21.32	277	25.87	386	25.55	325	541	711	−170
June 8	1.35	23.52	288	17.81	220	26.76	341	26.68	344	508	685	−177
July 8	3.20	24.39	302	22.38	293	23.62	289	18.35	213	595	502	93
August 8	5.64	24.78	308	19.28	242	25.05	312	19.07	223	550	535	15
September 8	8.47	24.16	298	21.65	280	21.28	252	20.50	244	578	496	82
October 8	12.28	25.26	316	22.39	293	27.60	356	22.07	268	609	624	15
November 8	12.88	25.79	325	22.83	300	26.14	330	23.35	288	625	618	7

The one field, S A, had been in crop in 1899 and was fallowed in 1900, while the other field, S B, had been in fallow in 1899 and bore a cereal crop in 1900. The kind of cereal is not stated in the publication referred to, but the dates of seeding, April 30, and of harvest, August 14, are given. The only crop having these dates was a 5-acre field of oats, which had been badly injured by wind, but produced 3,843 pounds of dry matter per acre. The seasons of 1899 and 1900 were in many respects unusually favorable for the experiments. The latter part of 1899 had been very dry, as may be seen from Table III, while from the opening of spring in 1900 until August 2 only 3.45 inches of rain fell, this being the driest crop season on record at Indian Head, with the exception of that of 1894. Wheat harvest began on August 2 and oat harvest on August 3. The moisture content in fields of cereals had probably been reduced to a very low point at the end of the summer of 1899, while the rainfall of May and June had furnished the fallow with a good supply of water. April and May of 1900 were very dry. The weather was unusually unfavorable for crops on stubble, as shown by Table VII. The full benefit of the fallow was shown in 1900. Nevertheless, the greatest difference shown by the samples taken to a depth of 16 inches was only 215 tons of water per acre, equivalent to less than 2 inches of rainfall. Heavy rains on August 2 (0.73 inch) and 6 (1.4 inches), with a shower (0.05 inch) on the 7th, raised the moisture content before the samples were taken on August 8. Similarly, the taking of samples in July had been preceded by rain, 0.01 inch on July 4, 0.95 inch on the 5th, and 0.42 inch on the 6th. Dry weather had prevailed before the samples were taken in May, June, and September. The crop of oats gave 3,843 pounds of dry matter per acre. This would have required 960 tons of water (equal to 8.5 inches of rain). It is very uncertain how much

the rain of August 6 to 12 (2.25 inches) had affected the crop yield. A field of 2.5 acres of oats, which ripened on August 3, yielded 4,688 pounds of dry matter per acre. It also had been injured by winds. There were only 3.45 inches of rainfall available for the crop, the rain on the day before harvest not being counted. The water required for the crop, however, was 1,172 tons per acre (equal to 10 inches of rain). A 9-acre field of oats, protected from the winds by trees, which ripened on August 10, yielded 6,273 pounds of dry matter per acre, requiring 1,568 tons of water per acre (equal to 13.7 inches of rain). The dry matter of all the fields of wheat ripening from August 2 to 9 averaged 3,333 pounds per acre. A field of wheat, ripe on August 2, yielded 3,510 pounds of dry matter per acre, requiring 8.75 inches of rain, whereas the actual rainfall of the season was only 3.45 inches, and the decrease in moisture of 16 inches of soil amounted to only 167 tons per acre (equal to 1.5 inches of rain). This would leave 3.8 inches of rain unaccounted for, even assuming that the surface evaporation was as low as that in the experiments of King. The soils of fields S A and S B, judging from the moisture content when they were driest, were not very dissimilar to those of F and G (described previously), at least to a depth of 16 inches. The season of 1905 at Moose Jaw was similar to that of 1899 at Indian Head, being such as to produce the maximum difference at the time of harvest between fallow fields and fields in grain. Further, as the water content of a soil changes little during a cold, rainless winter, the moisture should have changed but little between September, 1899, and May, 1900. The difference between fields S A and S B to a depth of 16 inches on May 8 was 170 tons per acre, and on June 8, 177 tons per acre, while that between fields F and G, to a depth of 18 inches, on September 9, 1905, was about 175 tons of free water per acre. The latter fields, however, showed a further difference of 508 tons of free water per acre between the eighteenth and sixtieth inches, at the latter depth both being equally moist. It appears probable that if the moisture content of field S A, determined to a depth of 6 feet on November 8, 1900, had been compared with that of the same field on May 8, or with that of field S B on August 8, the difference would have been much larger even than that which I found at Indian Head in the case of the same fields in different years and of adjacent fields in the same year.

The results of my investigations in Saskatchewan and my conclusions drawn from these investigations may be briefly stated. Most of the generalizations and conclusions, I believe, will apply to dry farming in western Nebraska and western Kansas where deep and retentive soils are considered. The soil in Saskatchewan does not at any depth remain frozen throughout the summer. The moisture stored in

the subsoil during the previous summer, and not the frost of the preceding winter, is the cause of the high yields of cereals. These high yields have in general been obtained from fields that were during the previous season in summer fallow or in cultivated crops, such as corn and potatoes. The roots of cereal and grass crops penetrate the subsoil to a depth of from 5 to 6 feet, even in seasons of unusually heavy and well-distributed rainfall. The total yield of dry matter of wheat, oats, and barley varies as the rainfall of the crop season, but shows a still closer relation to the total available moisture of the crop season. In the case of wheat the yield of grain from fallowed fields is largely independent of the rainfall of July and August, provided the rainfall of May and June has been abundant. Investigations of the fertility of the soils in which only the first 16 to 36 inches are considered do not furnish sufficient data upon which to base generalizations; in all such investigations the composition of the soil to a depth of 5 or 6 feet should be considered. The relative fertility of different areas seems to depend upon the nature of the subsoil rather than upon that of the surface soil, the latter in general being rich enough to produce very heavy crops when the moisture conditions are favorable.

Determinations of moisture, when these are not accompanied by determinations of the hygroscopic coefficient, are of comparatively little value in most cases. In semiarid regions roots go to the stored water, and the latter does not need to be elevated to the surface foot of soil. Comparatively little water is lost by direct evaporation from the subsoil below the first 12 inches. It is folly to begin dry-land demonstration experiments without having previously secured 6, or preferably 10, feet of good soil. In dry-land experiments tillage operations should be governed by actual determinations of the moisture conditions of the subsoil. The depth to which the determinations should be made depends upon the limit of the root penetration of the crop. After some experience the mere examination of the subsoil by hand and eye will give a fair idea of the moisture conditions. Accordingly, I expect to see all progressive dry-land farmers sooner or later provide themselves with an additional set of tools, namely, three soil augers, ranging in length from 3 to 9 feet.

CROP PRODUCTION UNDER HUMID AND DRY CONDITIONS.

By E. G. MONTGOMERY, *Agronomist, Nebraska Agricultural Experiment Station, Lincoln, Nebr.*

It is very difficult to secure reliable statistics in regard to the cost of crop production even when the most careful data are kept. This is due to the great variability in climatic conditions over which we have no control that increase or decrease the crop more or less in spite of our efforts. By referring to Table IV, giving the average cost of producing corn on the farm of the Standard Cattle Company for a period of eleven years, it will be noted that the cost varied from 11 to 29 cents per bushel. This great variation in cost was probably not due to either better or poorer methods of cultivation, but mainly to climatic conditions. As we go farther west in Nebraska we find still greater variation in the cost of production. Corn has been produced as low as 7 or 8 cents a bushel in the West, and sometimes has cost 30 or 40 cents. Western farmers years ago began to discover that there seemed to be little correlation between the crop yields and the amount of labor they put on the crops. They sometimes procured very large crops with almost no labor, and at other times everything was a complete failure no matter how carefully tended. This uncertainty of a sure return for labor is always disastrous to any class of people, and in time they are apt to depend more upon Providence than upon their own efforts for a living.

Let us investigate a little the conditions in western Nebraska which have brought about this uncertainty and examine briefly the type of farming that has developed as a result. By examining Table I, which gives the average rainfall for a period of thirty years, you will notice first a great fluctuation in the precipitation.

TABLE I.—*Average rainfall in different sections of Nebraska, 1876–1906.*

Year.	South-west.	West.	North-west.
	Inches.	*Inches.*	*Inches.*
1876	9.89	10.69	16.25
1877	19.38	20.11	12.46
1878	25.54	13.76	28.92
1879	27.03	24.05	16.32
1880	21.07	17.64	13.18
1881	35.48	22.93	18.15

TABLE I.—*Average rainfall in different sections of Nebraska, 1876–1906*—Cont'd.

Year.	South-west.	West.	North-west.
	Inches.	*Inches.*	*Inches.*
1882	25.94	17.95	17.54
1883	31.17	30.01	24.36
1884	26.94	13.53	13.81
1885	33.28	22.03	18.81
1886	30.43	16.84	14.43
1887	24.60	18.98	21.64
1888	21.17	13.80	20.31
1889	28.11	16.46	18.75
1890	13.43	12.00	15.81
1891	33.82	23.75	24.73
1892	22.43	19.72	27.89
1893	15.67	10.28	14.38
1894	10.33	11.30	12.54
1895	20.14	11.18	15.28
1896	24.35	17.31	19.48
1897	21.94	19.52	19.10
1898	22.23	16.65	15.57
1899	16.76	13.42	16.25
1900	18.56	14.90	19.61
1901	20.34	16.70	22.53
1902	28.05	21.27	19.17
1903	25.50	14.36	19.88
1904	22.89	15.92	18.19
1905	33.30	24.81	25.52
1906	23.51	23.81	23.48
Mean	23.73	17.60	18.85

Upon two occasions the whole southwestern section has had 10 inches or less of rainfall, while it has also had over 33 inches four different years out of the last thirty. In the western section they have had only 10 to 14 inches of rainfall eight years out of thirty, while they have had as high as 30 inches one year and 22 or more seven years out of the thirty. The figures for the northwestern section are similar. There is much evidence to indicate that with about 22 inches of rainfall they are reasonably sure of a crop with almost any kind of farming in the western portion of the State. On that basis the southwestern section of the State would raise a crop about half of the time, while the western section would raise a crop seven years out of thirty, or about one crop in four years.

Perhaps a better idea of the variability of rainfall may be obtained by examining particular points, as it is not always fair to take the average rainfall for a large region in the West. Rainfall is very apt to be local, especially in western Kansas and Nebraska. This is brought out in Table II, where we have tabulated the rainfall for three different localities in western Nebraska—Culbertson in the southwestern part, Sidney and Kimball in the western part, and Fort Robinson in the northwestern part.

TABLE II.—*Rainfall at three points in western Nebraska, 1884 to 1905.*

Year.	Culbertson.	Sidney and Kimball.	Fort Robinson.
	Inches.	*Inches.*	*Inches.*
1884	....	....	13.9
1885	....	....	19.0
1886	....	7.7	11.0
1887	....	17.4	25.2
1888	....	10.9	17.5
1889	20.6	14.6	13.9
1890	13.9	12.1	11.7
1891	30.6	18.4	18.7
1892	23.0	21.4	32.3
1893	....	8.6	10.8
1894	6.8	....	14.4
1895	19.8	11.1	14.6
1896	18.4	....	12.6
1897	28.9	20.9	10.4
1898	19.7	18.0	14.1
1899	17.7	12.2	14.3
1900	15.4	14.9	19.6
1901	16.8	17.5	19.8
1902	23.8	17.3	19.5
1903	20.7	13.6	16.8
1904	20.0	13.2	13.9
1905	26.1	25.5	....
Average	20.0	15.3	16.49

Culbertson.—Average for sixteen years, 20.01 inches; five years, over 23 inches; eleven years, over 18 inches; three years, 15 inches or less.

Sidney and Kimball.—Average for eighteen years, 15.3 inches; three years, over 20 inches; five years, over 18 inches; four years, 11 inches or less.

Fort Robinson.—Average for twenty-two years, 16.49 inches; two years, over 25 inches; seven years, over 18 inches; four years, 11 inches or less.

At Fort Robinson, with an average rainfall of 16.49 inches, which is almost below the minimum for crop production, they have had over 25 inches for two years out of the past twenty-two, and over 18 inches seven years out of the twenty-two, while they have had 11 inches of rain or less four years. There is no exact correlation between rainfall and crop production in this region, as hot winds or insects may easily destroy the crop even with plenty of rainfall. However, we know that a number of very good crops have been raised in that region, as much as 30 bushels of wheat and 60 or 70 bushels of oats within the last few years, and there seems to be evidence that with 18 or 20 inches of rainfall in this region the farmers are reasonably sure of a good crop. On that basis we might assume that at Fort Robinson they have had seven crops in the last twenty-two years, a light crop a number of other years, and a few complete failures. At Sidney they have had sufficient rainfall for a crop three or four years out of the past eighteen and a number of failures, while at Culbertson it would seem that they have had sufficient rainfall for a crop probably half the time. Table III illustrates in a more graphic way the variability of rainfall in this region, both for the crop season and for the year.

TABLE III.—*Variability of rainfall at points in Nebraska, Minnesota, Iowa, and Missouri.*

Locality.	Crop season (April to August, inclusive).			For the year.	
	Normal rainfall.	Variability.		Normal rainfall.	Variability.
	Inches.	*Inches.*	*Per cent.*	*Inches.*	*Per cent.*
Fort Robinson, Nebr	10.88	4.47	41	16.49	23
Kimball, Nebr	10.96	4.66	43	15.50	33
Culbertson, Nebr	14.37	6.86	48	20.70	21
Lincoln, Nebr			48	27.95	24
St. Paul, Minn					13
Davenport, Iowa					16
St. Louis, Mo					14

The variability of rainfall during the crop season is from 41 per cent to 48 per cent at the three points first mentioned, while it is 21 per cent to 33 per cent for the year. It will also be seen that the per cent of variability is 48 at Lincoln. However, the annual rainfall is 28 inches at Lincoln and 15½ inches at Kimball, and a variability of 40 per cent makes a greater difference where the normal rainfall is really below the minimum necessary for crop production than where the rainfall is considerably above the minimum. For comparison, the variability of rainfall at several other well-known points is also given. The great uncertainty of crop production in this region has resulted in a type of farming somewhat peculiar to the West and in some ways rather a practical adaptation to the conditions. The people of this region are not shiftless, but are both practical and optimistic and deserve some credit for their ability to adapt their methods of cultivation to a climate of this nature and be able to succeed as well as they do. The principle in most of the farming seems to be to put as little expense as possible into the farming of an acre of ground, on the theory that if rains come a good crop will be produced and if rains do not come nothing will be produced under any conditions. This enables them to farm more extensively and to cultivate the land at one-third to one-half as much expense as in eastern Nebraska; hence, if they secure a crop one-half or one-third of the time it is produced almost as cheaply as a crop in eastern Nebraska. Their cheaper cultivation is due partly to the fact that weeds are less troublesome and partly to the fact that, owing to the drier seasons, the soil is kept in good tilth much easier. However, this should not be too encouraging, as there are many disadvantages connected with securing a crop only once in two or three years even though it may be produced as cheaply as a crop every year. However, it is this question of comparative cost of production under different conditions and with different systems of farming that really tests the merits of the case. The western farmers are now practicing an extensive system of farm-

ing, but a good deal is being said about the use of an intensive system of most extreme type. Just how far we shall proceed toward the intensive system must be determined solely on the comparative cost of production between the extensive and intensive systems of farming under western conditions.

In regard to the present cost of producing crops in the more humid and in the drier portions of the State it is not easy to secure reliable statistics. Table IV shows that for a period of eleven years, from 1889 to 1899, inclusive, it cost the Standard Cattle Company, at Ames, Nebr., an average of 19 cents a bushel to produce corn on an annual area of about 2,000 acres.

TABLE IV.—*Cost of producing corn at Ames, in eastern Nebraska, 1889–1899.*

Year.	Total acreage.	Yield per acre.	Total cost.	Cost per acre.	Cost per bushel.
	Acres.	*Bushels.*			*Cents.*
1889	1,485	27.0	$4,867.42	$3.28	12.2
1890	1,485	22.5	8,924.79	6.01	26.7
1891	1,825	23.0	9,154.20	5.01	22.0
1892	1,825	28.0	9,499.97	5.20	18.5
1893	1,325	45.3	9,198.80	6.93	15.3
1894	1,792	22.8	11,950.83	6.66	29.1
1895	1,875	40.6	14,181.48	7.56	18.6
1896	2,462	68.6	19,888.70	8.08	11.7
1897	2,717	41.1	17,772.85	6.54	15.9
1898	3,431	31.5	21,575.89	6.32	20.1
1899	1,644	35.9	12,015.80	7.53	20.0
Average	1,987	35.1	12,639.80	6.28	19.1

The average cost per acre was $6.28. However, the annual cost per acre varied from $3.28 to $8.08, and it will be noticed that the cheapest corn was produced the year when it cost most per acre, and the next cheapest corn when it cost the least per acre. Since these data were taken, the rent of the land and the price of labor have advanced from 25 to 50 per cent, so that corn in the same region at present would probably cost 23 cents or 24 cents per bushel to produce.

A few years ago Mr. Coburn collected data from fifty-four counties in eastern Kansas on the cost of producing corn. He showed that the average cost of corn for the ten years previous was 20½ cents a bushel. However, the rent of the land and the cost of labor have also gone up in Kansas about the same as in Nebraska, so that, if data were collected now, they would probably show that corn in Kansas is costing 23 or 24 cents. In Table V I have attempted to compile a few data showing the average cost of production of crops in Kansas and Nebraska. The first part of the table is compiled from Mr. Coburn's reports for the years 1897 to 1906, inclusive. Nine counties were selected in northeastern Kansas and nine counties in northwestern Kansas.

TABLE V.—*Cost of producing corn in Kansas and Nebraska, 1897–1906, inclusive.*

AVERAGE IN KANSAS.

	Northeastern Kansas.		Northwestern Kansas.	
	Corn.	Winter wheat.	Corn.	Winter wheat.
Yield per acre, bushels	26.3	16.6	13.5	9.77
Value per acre	$8.92	$10.82	$4.52	$5.68
Value per bushel	$0.336	$0.649	$0.356	$0.573
Cost per acre [a]	$6.60	$7.35	$3.00	$4.35
Cost per bushel [a]	$0.25	$0.44	$0.22	$0.45

[a] Estimated.

AVERAGE IN NEBRASKA.

	Eastern Nebraska.		Western Nebraska.	
	Corn.	Winter wheat.	Corn.	Winter wheat.
Yield per acre, bushels	33	18	15	10
Cost per acre	$6.60	$7.35	$3.00	$4.35
Cost per bushel	$0.20	$0.40	$0.20	$0.43

AVERAGE FOR KANSAS AND NEBRASKA.

Cost per bushel	$0.225	$0.42	$0.21	$0.44

From these tables it will be seen that the average yield of corn in northeastern Kansas in ten years has been 26.3 bushels per acre, and for the nine counties in northwestern Kansas, 13.5 bushels, practically one-half as much. The average price per bushel in western Kansas has been about 2 cents more, and the average value per acre about one-half as much. I have made a careful estimate of the cost of producing corn in eastern and western Nebraska, and assuming that it costs about the same in Kansas I use this to get the average cost of production in eastern and western Kansas. My figure for producing corn in eastern Nebraska is $6.60, counting rent at $3 per acre; labor of a man, $1 per day; of man, team, and tools, $3 per day.

A few years ago Mr. Coburn made an estimate of $5.73 as the cost of production in eastern Kansas, but as rent of land and labor were cheaper it is certainly more than that to-day. In western Nebraska I have estimated the cost of production at about $3 per acre. This difference in cost is due largely to the fact that they list more and plow much less, that the rent of land is about $1.50 cheaper per acre, and that fewer cultivations are necessary to destroy the weeds. Large tools are also used, and the ground worked more rapidly. I believe that $3 per acre is a fair estimate. On this basis corn in eastern Kansas for the past ten years has cost 25 cents a bushel and corn in western Kansas 22 cents.

Winter wheat has averaged 15.6 bushels for eastern Kansas and 9.77 bushels for western Kansas, about three-fifths as much for the

west as for the east. I have again used my Nebraska estimates for the cost of production of wheat in eastern and western Nebraska. According to this estimate wheat has cost 44 cents per bushel in eastern Kansas and 45 cents in western Kansas. In obtaining the yield per acre my source of statistics has not been as extensive for Nebraska as for Kansas, but I have made as close an estimate as possible from the data at hand. According to these I would place the cost of producing corn at 20 cents for eastern and western Nebraska and wheat at 40 cents for eastern Nebraska and 42 cents for western. I think there probably is no real difference in cost per bushel between Kansas and Nebraska, but I am using the best statistics I can secure.

If my figures are at all reliable they show that at present, at least for the period of the last ten years, corn and wheat have been produced about as cheaply per bushel in western Kansas and Nebraska as they have in the eastern part of those States. From this it would seem that at least until the rent of land increases they are doing fairly good farming in the western sections. It must not be concluded, however, that because they raise grain as cheaply by the bushel their farming is as profitable, because there are many disadvantages with raising crops only a part of the time as compared with raising crops every year. For comparison, I desired to obtain some data in regard to cost of production under more intensive farming in the western areas, but was unable to find such data. It is to be regretted that some such data are not at hand, for upon the cost of production will depend the development of the intensive system of farming.

It must be remembered that the merits of a system of farming are not determined by what some one can figure out ought to be made by it, or even by what some expert is able to accomplish. For example, anyone ought to be able to figure out with the stub end of a lead pencil that farmers in eastern Nebraska should raise corn at 15 cents per bushel, and a few farmers are doing this, but it does not prove that the average farmer has the ability to do this. In the same way, while some of the intensive systems of dry-land farming seem all right in theory, we can not judge of their merits until thoroughly tried in the hands of farmers. The value of the system depends on what the farmers as a class may be able to do with it. No matter how good the system may be in theory or in the hands of an expert, if it is too complicated or the principles are too difficult to grasp by the average farmer, the system must be considered impractical.

This emphasizes the importance of collecting accurate data, not only on the cost of producing farm crops under average methods of farm practice but under more intensive systems as well.

BLOWING SOILS.

By L. E. Hazen, *Assistant in Dry-Land Agriculture, Hays Substation, Hays, Kans.*

The long-continued droughts in the semiarid belt are no more of a proposition than the excessive winds. As a rule such crops as wheat, barley, rye, sorghum, cowpeas, and Kafir corn will withstand a drought of six weeks to two months fairly well if there is no wind. Alfalfa will grow on 11 per cent of water in the first 3 feet, retaining a rich green color; two hours of 40-mile wind will stop all growth and cause a yellow tinge to appear on the leaves with 18 to 20 per cent of water in the soil and an air temperature of not over 80° F.

There has been much written to explain how to establish a soil mulch, but so far there is little information as to how to keep it. A dust mulch will check evaporation, but the first stiff wind will blow the mulch away. Because this fact is overlooked land is being sold in western Kansas and eastern Colorado for $10 an acre which is really not worth $5. The clean-cultivated land at Hays blows very badly, each spring, as the records show: land which is lightly tilled does not suffer much.

The following is the cultivation history of the worst-blown land on the reservation this spring:

In November, 1904, the land was plowed and harrowed; in March it was again harrowed and was planted to spring crops—wheat, oats, and barley. The part of the field west of the road was disked and harrowed in mid-April, plowed in July, and harrowed but not packed, as heavy rain beat it down; August 6 it was harrowed to break the crust and kill weeds; September 30, drilling winter wheat commenced.

In the records the following comments are noted:

March 1, 1905.—During the three days' high winds this whole field blowed badly and considerable wheat is covered because of the flying dirt particles having lodged behind sorghum stalks and in low places. Wheat plants appear rather sickly, though the part in the ground is alive and thrifty.

April 24, 1906.—The high wind of to-day did much damage to all spring crops that were above ground, and the barley and spring wheat east of the road were affected most because of the constant drifting of particles from the wheat fields on the west side of the road.

April 26 to 30.—Where wheat is killed the ground is listed to corn.

May 28 to 31.—Cultivated with a 6-disk cultivator. Weather is dry. Cultivation completed June 4.

June 8 to 18.—Second cultivation. A special weeder was used after to conserve moisture; completed weeding 20th.

June 27 to July 3.—Cultivated the third time.

July 25.—Used spiked plank.

July 27.—Rain stopped this work.

August 4.—Commenced using one-horse cultivator between rows to make mulch. Cultivation continued until crop matured.

March 8 to 10, 1907.—Stalks raked and burned and disking commenced.

February 18 to 20.—In another part of this flat the fall-plowed land was gone over with a disk drill having press wheels on to prevent blowing and drifting; wind has been blowing at the rate of 40 miles for a day or two and part of the land has drifted.

It was noted from time to time that rough-harrowed land or that gone over in an east and west direction with a drill did not blow much in a 40-mile wind, but that broken by a special harrow did blow some. To determine the real value of rough harrowing, five 2-foot-square plats were laid off side by side on the hill south of the evaporation tank and the plats were treated as follows: No. 1 was a check plat, its surface being entirely free from vegetation, but no cultivation was given. No. 2 was rough-harrowed east and west, but was not stirred enough to make the dirt fine. No. 3 was also rough-harrowed, but the cultivation was so frequent that it had a very fine mulch. No. 4 had a broken crust of the same quality as No. 2, but was laid smooth instead of in ridges. No. 5 had a very fine, level, mulch surface.

In a 30-mile wind no blowing of any consequence took place, although plat No. 5 showed signs of losing dust; in a 35-mile wind Nos. 4 and 5 both blew some. In a 40-mile wind Nos. 3, 4, and 5 blew, and the mulch from No. 5 had to be reestablished. No difference in rate of blowing could be detected between Nos. 4 and 5 until the wind dropped to 30 or 35 miles, when No. 5 alone lost dirt. In a 50-mile wind No. 2 showed signs of blowing, as did the check plat; in a 57-mile wind all four cultivated surfaces blew away, but the check plat blew very little. The conclusion arrived at is that rough harrowing has no great advantage in a high wind.

The Department of Horticulture has a small timber strip which surpasses anything for blowing the writer ever saw. It runs north and south along the fence next to the highway. This field grew barley in 1904, and about the middle of September it was plowed and harrowed. A number of lister rows were opened, tree seeds being dropped and covered with a cultivator. The field was again cultivated in April, and then was kept continually loose with hoe, disk, cultivator, a tooth and slicing harrow, and throughout the season had

a heavy dust mulch. The dust blew from this in clouds and drifted so thickly in the yard west of the boarding house as to kill weeds and grass in places.

An orchard plowed and harrowed this spring, then planted and intertilled, has not suffered from blowing as yet. The main tillage is east and west. This field was a big weed patch last year.

Trees do not start readily at Hays, but cottonwood and honey locust do fairly well, and where trees protect the south side of a field there is little blowing until a point is reached several rods from the protecting belt. Frequent timber belts running east and west, plenty of sod-forming crops, and care not to leave a smooth, fine-grained surface seem at present to be the best checks to this trouble.

PLANT BREEDING IN CONJUNCTION WITH DRY-LAND AGRICULTURE.

By L. R. WALDRON, *Superintendent Agricultural Substation, Dickinson, N. Dak.*

While the variety testing, plant selection, and plant breeding carried on at the various experiment stations connected with the semiarid belt can not fail to be of much benefit to our cooperative work, yet the ground may not be entirely covered and valuable work may be undertaken at the substations in immediate connection with the different cooperative projects. Any work of this character must be undertaken seriously, be well planned in advance, and funds must be set aside to carry it out. Obviously the work should be of as simple a nature as is consistent with the results to be obtained. Simple and well-tried methods applied along new lines may produce as satisfactory results as though more modern theories were used with a less sure hand.

In the past plant breeding, or perhaps more properly plant selection, has been devoted mainly to an increase of yield, an increase of rust resistance, of drought resistance, of hardiness, of milling quality, etc., and while these qualities are desirable and even necessary in our work, it may be that there are other qualities of equal value to be developed in grains which are to become preeminently suitable for our dry areas. Or may it not be possible that some of the qualities mentioned are really complexes which by appropriate methods may be analyzed into simpler elements? The terms vigor and hardiness may mean much or little, depending on the user's standpoint. We are learning that the term "drought resistance" has an increasingly wider meaning, subjectively; and until we know the methods by which the plant may overcome lack of moisture we may hope to make but little progress by selecting along this line.

What are some of the difficulties against which cereals have to contend in the area which interests us? Surely one of the difficulties, though not the chief, is the cold soil which the spring-sown grains find ready to receive them. At Dickinson this season some grain scattered from the thrasher germinated in March and maintained a successful growth until the first of June, when it was pastured, being far in advance of grain sown in early April, which did not appear

above ground until the first week of May. This great difference was evidently due almost wholly to the warmer substratum secured to the early germinating grain. Now, while it may be difficult to move the mountain Mahometward by warming the soil, it may be possible to dislodge Mahomet by modifying our grain. At any rate the idea is worth thinking about, and perhaps acting upon.

In a variety of grain is it not possible that there are some kernels which will start at a lower temperature than other kernels? From the writer's observation upon grain sprouted in a germinator at a rather low temperature it seems very probable that this is so. Proceeding on this assumption, it would seem but a simple matter to run the germinator at a temperature just below the degree necessary to cause germination for that particular variety, and from several thousand grains there may be one hundred which start at this lower temperature. These could be transplanted to the open ground and selection could then be made for yield and other qualities. The next year the selected grains could be put through the same or a more exacting germinator test and the work continued as long as desired.

From the writer's observation on the germination of certain weed seeds, it seems reasonable to suppose that the germinating temperature point varies widely with the seed of any one species and that those which germinate at the lower temperature are more frostproof than the remainder. If this should be found to be true of grains, we would be developing not only a strain that germinates at a low temperature, but one that is frost resistant also—a valuable desideratum.

We need not only a grain having the above germinating characters, but one that will germinate with a minimum amount of moisture. The ground at planting time in the semiarid regions is apt to contain less than the optimum water content for germination. A grain that would accommodate itself to the drier conditions would aid the farmer in making good in his struggle for maintenance. It would seem feasible to fit up a germinator having the moisture content under control. In such a germinator, having the moisture content just below the minimum for germination, there could be selected grains or seedlings requiring the minimum amount of moisture. Such seedlings could then be planted out.

These ideas could be carried out in a limited manner by purely out-of-door methods, but the work would be under better control and results would be attained more rapidly if the most essential portion of the work were carried on inside. Perhaps a method more suitable than that of the seed germinator would be that of a small glasshouse the temperature of which could be controlled. In such a place the plants could be started at the minimum temperature and later trans-

planted. In other beds, with the moisture content kept at certain percentages, seeds could be sown and the desired seedlings could be transplanted and treated as seemed best. In carrying out the above suggestions the idea of using the various methods in combination readily comes to mind.

While the difficulties attending plant selection carried on along the lines indicated are of some importance, yet it is believed that they are not insuperable, even to the substations. Furthermore, the beneficial results accruing should prove of much importance, not only as an end in themselves, but for the light that would be thrown upon other problems now scarcely guessed at.

RATE OF SOWING DURUM WHEAT.

By L. R. WALDRON, *Superintendent, Agricultural Substation, Dickinson, N. Dak.*[a]

The statement is often made, by scientists as well as by farmers, that in sowing durum wheats the drill should be set to sow more than if sowing Fife or Bluestem wheats. This statement seems to be based on three assumptions: (1) That the grains, being larger, feed more slowly through the drill; (2) that the grains, being larger, a greater volume per acre is needed in order that as many grains per acre be sown as of the common wheats; (3) that as the durums stool less, they need to be sown more thickly in order that as many heads per given area may be produced as in the case of the common wheats. These postulates overlap somewhat and can not all be used in the same argument.

Recently the author has made a little study with a view to testing the soundness of the practices derived from the above conclusions and also of the conclusions themselves. Two varieties of wheat were selected—Kubanka and Rysting's Fife. The Kubanka weighed 63 pounds and the Fife 61 pounds to the bushel. Ten grams of each variety were weighed, and in the durum sample there were found 247 grains, as against 304 grains in the Fife sample. This is an excess of 23 per cent of the Fife grains over durum for a given weight and only a fraction less than 23 per cent for a given volume.

Equal quantities—about 5 pounds each—of the two varieties were weighed out and each sample was placed in one half of a 6-foot drill having but one feed. The drill was set to sow 6 pecks of common wheat. Enough revolutions of the shaft were made to sow one-twentieth of an acre. The wheat that passed through the hose was collected and weighed. It was found that of the Kubanka there were 1,088 grams and of the Fife 1,079 grams that had passed through the drill, a difference of less than 1 per cent, although it was found that the durum grains were 123 per cent the size of the Fife grains. It thus appears that under the conditions given, the two wheats feed at about the same rate. If this holds generally, the first assumption is unfounded.

The second statement is self-evidently true; but is it necessary that more grains, or even as many grains, of the durum be sown per acre as of the Fife in order to produce the best results? It is true that

[a] Mr. Oliver J. Grace aided in securing some of the data for this paper.

the durums stool less, but is it necessary that they stool so much as the Fifes or Bluestems to produce as much per stool? Are there no other factors entering that tend to offset the deficiency in stooling? In an attempt to answer this question in part, weighings may be given of some stools of these two varieties. They were grown in nursery plats under similar conditions, except that the Fife wheat was sown twelve days later than the durum. Six durum stools and seven Fife stools were selected on the basis of general quality—primarily yield as expressed by stooling. Of the durum, the six stools averaged 4.3 heads to the stool. The shelled grain averaged 10.11 grams per stool. The seven best stools of the Fife averaged 6.8 heads per stool and the shelled grain averaged 6.62 grams per stool. The shelled grain per durum stool thus shows itself to be 52 per cent greater than similar grain from the Fife stools. The durum grain yielded on an average 2.35 grams per head, while the Fife wheat yielded but 0.97 gram per head, an excess of over 140 per cent in favor of the durum. To put the matter more concretely, in order to produce a crop of 30 bushels per acre it would require a stand, according to the figures given, of 16 stools of the Kubanka wheat per square yard, as against 25 stools of the Rysting's Fife. If we were to do any *a priori* reasoning from these figures, the conclusion certainly would not be that the durum wheat needs to be sown the more thickly—rather the reverse. While the data given do not aid us materially in field practice, they serve to brush away certain deductive conclusions and preconceived notions that might prevent a good understanding of the subject. There may be reasons for thicker sowing of the durum, but it is scarcely possible that they lie along the lines indicated at the beginning of this paper.

FRUIT GROWING ON THE PLAINS.

By J. E. PAYNE, *Superintendent, Agricultural Substation, Akron, Colo.*

One who has been accustomed to going to the orchard or fruit garden and eating fruit fresh from the trees can hardly imagine that it would be possible to live and raise a family without using fruit of some kind as an article of diet. When fruit is shipped a long distance it is never as good as the fruit which one would select from his own orchard, while the prices which must be paid for the inferior article which the stores occasionally have for sale are prohibitive to the average settler who files on a claim and attempts to eke out an existence for himself and family. So if the children of the Plains country are to have as much fruit as they should have it must be raised at home.

The Plains country is likely to be settled by people who can not get a foothold where land is high priced. They must learn to farm under conditions as they exist. They must find drought-resistant crops for extensive use, and must learn to create suitable conditions for the production of their favorite fruits and vegetables which are not drought resistant. In other words, they must adapt themselves to conditions and learn to create environments suitable for some plants which can not be grown in the community under natural conditions or ordinary methods of culture.

The agriculturists and agronomists are all working and studying to find or produce drought-resistant grains, grasses, and fruits. But I contend that these would avail but little if we could not find "drought-resistant" settlers who are willing to live in the country and demonstrate their value.

I have found that the quality of drought resistance is not confined to the settlers from any State or nation. It seems to be an individual trait instead of a quality of race or country. The man who can adapt himself to the conditions and do the right work at the proper time succeeds in maintaining himself, and those who do not do this fail.

It is argued and has been argued that it does not pay to try to grow fruit and vegetables on the Plains because they can be bought cheaper than they can be raised. But I have noticed that those who talk that way have a very small variety of vegetables on their tables and that they seldom eat fruit of any kind, except the cheapest kind of dried fruit, unless perchance the man happens to be owner of a

large ranch from which a few hundred "feeders" are annually sold. Even the wealthiest ranchmen fail to find good fruit and vegetables on the market at all times, and they can supply themselves only by maintaining an orchard and garden for the production of their own supplies of this kind.

Fruit growing, gardening, and forestry as practiced by the ordinary farmer or ranchman are business propositions which it is impossible to demonstrate will pay in dollars and cents for all the work put into them. But as a factor in home building it certainly is easily shown that a good supply of fresh vegetables and fruits is worth all it costs in labor and money, especially when one must either produce his own supply or go without.

Farming as practiced by the majority of men owning the land which they use is a home-building proposition instead of a business venture. Some men I have known whose annual production would not average $500 cash market value per year have lived on the Plains and raised large families. As wages for a man and his wife and children, all working hard, this does not seem like a business proposition. But the same man, if placed in some factory, would have to earn all the income, and he would not earn any more than the family earns on the drought-stricken prairie. If the father was employed in a factory the children would miss the sturdy training in thrift and industry that helping with the stock and doing farm work give. So, while at first the settler may appear to be playing a losing game, when we consider ultimate aims he has probably done more for his family and for society at large by raising a few honest, industrious men and women, who will also be "drought resistant," than he could do in any other way, and they will be able to give efficient aid in conquering the remainder of the American desert.

Introduced trees and shrubs which have been tested have often given results not on account of drought-resistant qualities but because their fruit grew and ripened during the part of the year when humid conditions existed.

Cherries, plums, and gooseberries have usually produced well. Only standard varieties of these have been tested by the writer, and it is his belief that they have succeeded because they make their growth of fruit before July 1, or before the usual time of drought. The Russian mulberry can also be depended upon to produce considerable fruit, which gives much pleasure to birds and children, and several varieties produced fruit at Cheyenne Wells. The sand cherry and the wild black currant are found native in many parts of the Plains area. These also grow their fruit mainly during the humid parts of the year. Apples have not been successfully grown without irrigation, except during periods of excessive rainfall. Apple trees have been grown in many places on the Plains by careful tillage, but

nearly every year there is a time when the fruit is injured by drought. If the owner is prepared to give the trees a good irrigation at these critical times, they will produce good fruit. Otherwise much of the fruit falls and that which remains does not ripen properly, but withers and never has a good flavor.

As water is necessary for trees or gardens, these should be located where it will be possible to give the trees extra water in some way and also guard against an accumulation of excess water about their roots in times of heavy rainfall. The ideal location for an orchard is on a slope adjoining permanent pasture land, where the storm water may be carried to ditches made just above the rows of trees and distributed automatically during the storm, each tree to have a hole just above it on the slope, which will be filled from the prairie flood water. This method is shown in the map of James Howell's orchard, which is situated near Flagler, Colo. (See fig. 1.) The mistake of not providing for drainage is shown in the same orchard. The trees planted in the creek bed below the dam were much damaged by extra water during a season of excessive rainfall. During dry years they did well, but when a series of years having abnormal rainfall came many trees planted in the old creek bed died.

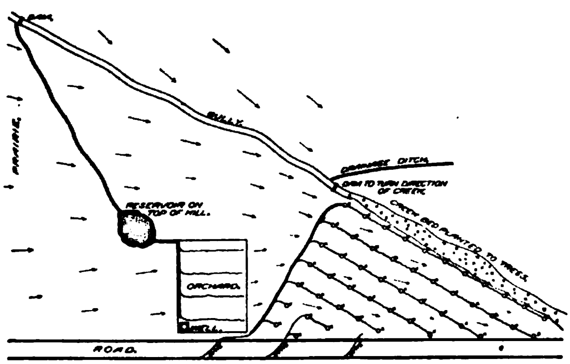

FIG. 1.—Diagram of James Howell's orchard, Flagler, Colo.

Having chosen the location, the next thing to consider is the preparation of the land. Two extreme methods have been practiced, both with fair success. One is merely to dig holes for the trees and set them in the sod; the other is to plow the land several times during one year, each time a little deeper, and again in the spring just before planting. At this last plowing the tract is plowed in narrow lands, so that each row of trees will be planted in a dead furrow. Holes are dug and the trees set carefully with roots naturally spread. The top soil should be thrown in first and carefully packed. Trees should not be set when the ground is wet. The trees should be set and covered a little deeper than they were in the nursery row. The holes should be deep enough to be left with about 6 inches unfilled. This, with the furrow in which the holes were dug, will make a reservoir for holding storm water until it can sink into the ground. The trees planted

should be trimmed so as to balance the root system and the top. Cut off all bruised roots and limbs and leave the limbs which are in position to make each tree well balanced. Pruning in after years will be likely confined to cutting out interfering branches. Each year more wood will be cut out, until after a few years a wagon load of brush will be cut from an acre of apple trees each year. Pruning should be done just before the growth starts in the spring, so that the wounds will quickly heal before they are exposed to dry, cold winds.

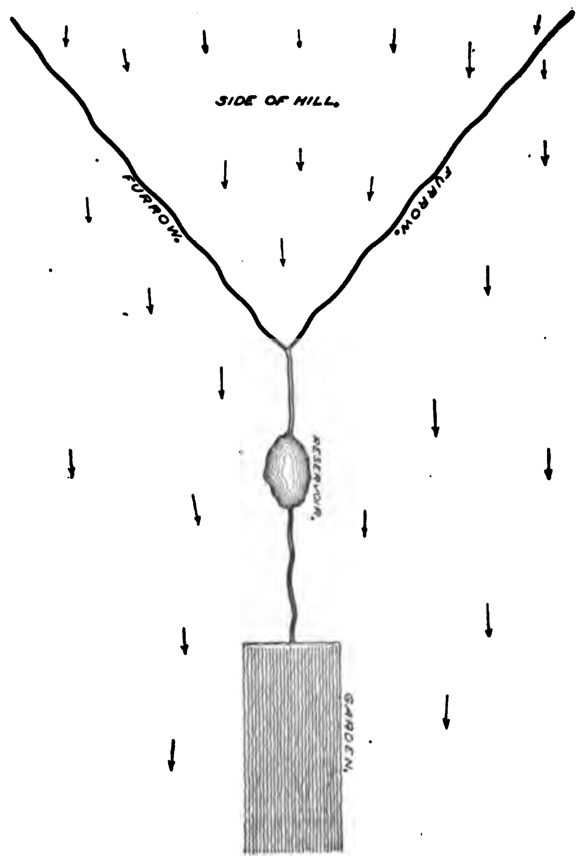

FIG. 2.—Diagram showing simple method of utilizing storm waters.

The orchard should be cultivated carefully, so as to keep the weeds down and preserve a soil mulch. The disk harrow is probably the best tool we have for maintaining a deep soil mulch. The smoothing harrow used with teeth set slanting forward is good for maintaining a moderately deep mulch. I have always begun cultivation early in March and stopped by August 15. Some years the orchard was not cultivated after July 31. Frequency of cultivation depended upon rainfall. The tool used for any cultivation also depended upon the condition of the ground. I never tried a cover crop, as I had the care of one orchard only eight years, and it grew well under clean culture and was not large enough to make any tests which would have been of any value.

The fruit garden should not be extensive, but should include enough trees of each kind to furnish a succession during the summer and an

abundant supply for winter use. It should be surrounded by a windbreak of hardy trees. I would now plant three rows of hardy trees 8 feet apart each way if I were planning a garden. I would use Russian mulberry, black locust, and wild Russian olive for making the shelter belt. The black locust and wild olive are ornamental trees, and the Russian mulberry bears fruit which is quite acceptable to the bird friends and children.

The work done in testing fruit trees has been pioneer work only. It has been demonstrated that fruit trees will grow in the Plains country if cared for properly. Variety tests should follow. We have produced good crops of Weaver, Minor, and Wolf plums; also good crops of Early Richmond, Early May, and English Morello cherries. The Downing gooseberry has done well. Apples of standard sorts, as Ben Davis, Missouri Pippin, Winesap, and Duchess of Oldenburg have all thrived and have borne a few good crops. Peaches have often winter-killed, so if any of them are raised hardy sorts must be imported or the trees must be covered during the winter. Apricots make beautiful trees, but they nearly always blossom too soon in the spring to produce a crop of fruit. Standard grape varieties, such as Concord and Delaware, produce vegetative growth, but seldom fruit.

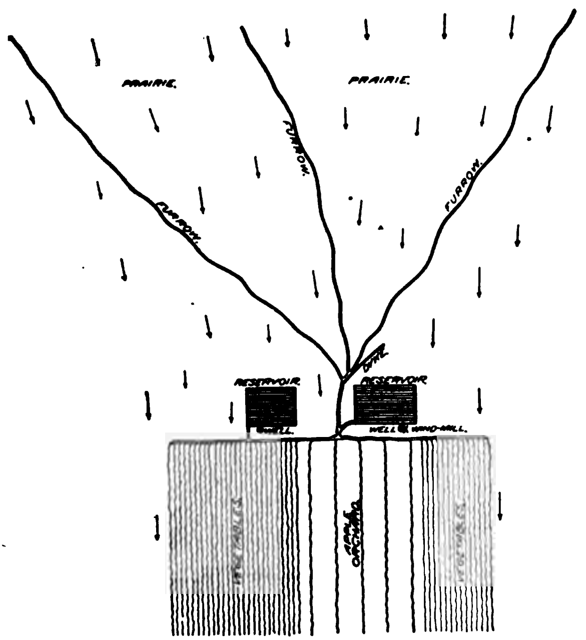

FIG. 3.—Diagram showing combination of windmill irrigation and utilization of storm waters near Akron, Colo.

After protection from the storms, the most important consideration in the production of fruit is a certain water supply in time of need. Some try to store this in the soil by cultivation, and when storm water can be drained from other land onto the fruit garden this method is a success. But during dry years trees suffer if they get only the water that can be saved from the rain which falls upon the space occupied by the orchard.

Another method is by irrigating from wells. Some use a combination of these two methods.

In the accompanying illustrations are shown some methods of getting extra water for the fruit garden. Figure 2 shows a simple method of catching the water from a hillside and storing it in a buffalo wallow situated above the garden. This reservoir is fed by a deep-trodden cattle path. It holds water for several days and this is put upon the garden where it is most needed.

Figure 1 shows a more complicated system involving the same general plan and used in combination with a well, so that if the storm water does not come at the right time the trees may be watered from the well. This garden is located near Flagler, Colo. The reservoir on the hill is fed from the prairie by throwing a dam across the head of an arroyo or gully and making a ditch from above the dam to the reservoir. The same arroyo is dammed lower down and turned out of its course, leaving the old channel dry but subirrigated from the pond above the dam. Trees were planted in the old channel, but the wet years of 1904 and 1905 caused them to be much damaged by too much water standing about their roots and many of them died. During the dry years these trees did well. The trees planted upon the slope get the storm water from the higher land and the holes above the trees on the slope are often filled. This extra water, combined with good cultivation, has kept the trees on the slope in good condition and able to bear fruit every year, although the crop is sometimes destroyed by hail. This fruit garden was set out about fifteen years ago and drought has caused no failures there.

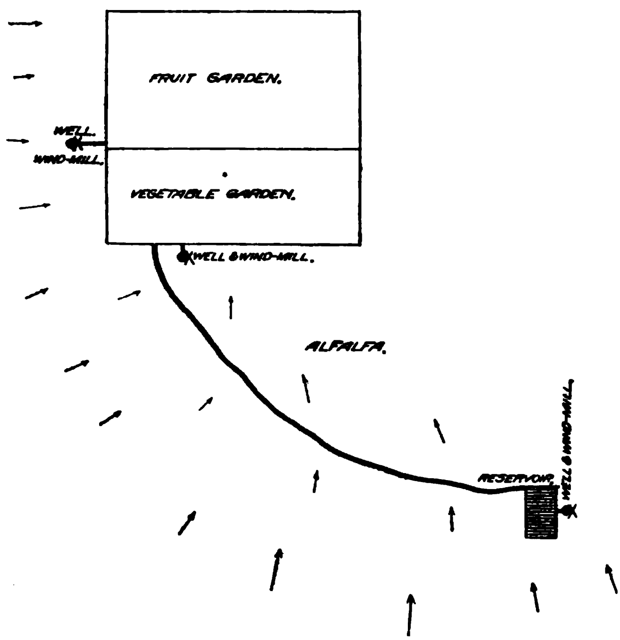

FIG. 4.—Diagram showing windmill irrigation as practiced by John Rose, Seibert, Colo.

Figure 3 shows another combination of the use of storm water, with windmill irrigation. This is a commercial fruit and vegetable garden. It is located near Akron, Colo., and the owner has supplied the community with vegetables and small fruit for several years. The storm water is used to water the trees and large crops, while the water from the wells is stored and used for watering vegetables. This garden has furnished an income of about $800 a year, besides the ice crop from the reservoir, which often amounts to $500 a year.

Figure 4 shows a type of windmill irrigation plant of which there are many on the Plains. The one chosen belongs to a pioneer in this line, Mr. John Rose, who is located near Seibert, Colo. Mr. Rose began with one well and no mill. Later a mill was obtained, but blew down, and until it was put up again, several weeks later, Mrs. Rose pumped water by hand five hours every day in order to save her strawberries and trees. This garden was only a few square rods in extent at first, but it was extended as experience dictated until now three wells water about three acres. Mrs. Rose says that the little fruit garden enabled the family to live when they would have been compelled to leave if their garden had not been a success. Many of their neighbors sneered at the "little patch" at first, but now, after eighteen years of demonstration, every settler within 10 miles of Mr. Rose has a small fruit garden, and they have nearly all obtained strawberry plants from that pioneer fruit farmer.

There is no doubt that every man can have a fruit garden if he is willing to make sacrifices to start it and care for it; but he must remember to make conditions to suit the plants, instead of trying to change the plants to drought-resistant varieties.

OKLAHOMA ROTATIONS AND THEIR RELATION TO SOIL-CULTURE WORK.

By L. A. Moorhouse, *Agronomist, Oklahoma Agricultural Experiment Station, Stillwater, Okla.*

Rotation of crops in agriculture and horticulture has been defined as the system or practice of growing a recurring series of different annual crops upon the same piece of land. The system is based on the fact that various crops not only require but absorb different quantities of the mineral constituents of the soil; hence, if one crop is grown continuously upon the same section of land for a period of years and one of the essential elements is drawn upon to an excessive degree, it is evident that unless the supply of this constituent is present in unlimited quantities, the plant food elements will be thrown out of balance and low crop yields will result. Sir Henry Gilbert, in presenting a review of the rotation experiments at the Rothamsted station, gives us the following definition:

> If I had to define the practice of rotation of crops as followed in our own country (England)—indeed, over large portions of Europe—in the fewest possible words, I should say that it consists in the alternation of root crops and of leguminous crops with cereals. In the United States, however, it is a gramineous crop (maize) which largely takes the place of the root crops in Europe.

The same writer also makes the following observations:

> The cereals constituting such a very important element of human food, it was natural that they should be grown almost continuously so long as the land would yield remunerative crops. Hence, the history of agriculture, not only in our own country but in others where these crops were of high relative value, shows that it very generally came to be the custom to grow them for a number of years in succession and then to have recourse to bare fallow, or in some cases to abandon the land to the growth of rough and weedy herbage, affording scanty food for domestic animals.

This is precisely the history of agriculture in this country. First, the one-crop system constitutes the sole arrangement for the farm; then a reduction in yield necessitates some modification, and we note that an abandoned farm is the final outcome. History must not repeat itself in the West. With all our modern ideas in the realm of chemistry, with new light in the field of biology, and with a mass of experimental data from the physical laboratory, where the soil is carefully studied, the problems which are confronting the agriculturist of the West should not go unsolved. It is my belief that we are coming

to a plane where more substantial experimental work can be planned and carried into effect, but this fact should not lead us to relax our efforts or to conclude that the goal has been reached, for it appears to me that we are merely commencing to grasp first principles.

Several reasons may be advanced in favor of a well-planned rotation. In the first place, the adoption of such a system will enable the husbandman to distribute the farm labor throughout the greater part of the year; thus men who were formerly engaged for short periods will be given continuous employment. Again, a variety of crops, marketed at different periods of the year, gives a steady and regular income to the farmer, and, as a matter of fact, he will be able to manipulate his affairs with a smaller capital. Success in commercial life depends to a great extent on the business management, and this is also true in regard to agricultural pursuits. A good rotation affords an opportunity for making regular applications of farm manure on the respective areas; hence, the fertility of the soil will not deteriorate as rapidly as under the one-crop system, where manure is added sparingly; moreover, clean-culture crops can alternate with uncultivated crops and weeds may be held in check quite effectively. These and other reasons which might be given are decidedly in favor of a definite system in the order of cropping.

One of the first questions which comes to us in making suggestions for the farmers of the West is this: "What factors should be observed in planning a rotation?" This question can not be answered for us from the standpoint of the eastern farmer, although the latter might receive instruction by observing western methods, and we can undoubtedly profit by investigating his plans. It is possible that some of our failures in the semiarid region have been due largely to a strict adherence to some local ideas which have been imbibed under entirely different surroundings. The newcomer must learn to adapt himself to new conditions, and in order to do this successfully a study of the past history of this great area will be imperative. The conservation of soil moisture is an important item; thus, if maximum returns are to be secured, this factor must be reckoned with in the arrangement of our rotation.

In discussing these factors it will be necessary for me to confine my attention to data which have been collected during the past ten years at the Oklahoma Agricultural Experiment Station. The rainfall for this point is much higher than the rainfall which is reported for western parts of the territory; however, if any general deductions can be made in a study of our records for this county, a few of these lessons may be applicable under western conditions.

In the first place, let us consider the precipitation throughout a period of years, and perchance we may determine the relation between

the rainfall and our crop systems. Our records are complete for the years 1896 to 1906, inclusive; and the monthly distribution for this period is given for two five-year periods. The average for the first five years—1896–1900—is given in Table I, while the average for the second period—1901–1905—is given in Table II. The latter table also contains a ten-year average. The report blanks from which these figures were taken were apparently incomplete for the years 1893 to 1895, inclusive, consequently it would hardly be correct to make any comment for this period.

TABLE I.—*Precipitation at the Oklahoma Agricultural Experiment Station for 1896 to 1900, inclusive.*

Month.	1896.	1897.	1898.	1899.	1900.	Average, 5 years.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	0.55	0.76	3.53	0.48	0.23	1.11
February	19	1.51	3.00	.47	.79	1.19
March	1 21	3.61	2.75	1.03	.51	1.80
April	.94	6.86	.58	4.97	4.43	3.46
May	5.98	4.77	8.56	5.61	3.71	5.72
June	7.26	4.13	4.72	3.64	3.28	4.61
July	5.85	2.63	6.35	4.54	2.69	4.41
August	1.64	4.51	2.86	2.57	1.39	2.59
September	2.54	71	2.72	.88	9.22	3.21
October	2.88	97	4.19	5.15	2.87	3.21
November	1.56	.80	.68	1.93	.65	1.12
December	.85	.87	2.68	1.60	.21	1.24
Year	31.40	31.53	42.62	32.87	29.98	33.68

The snowfall for this five-year period was not excessive, and yet there was sufficient to furnish at times a fair supply of moisture for the soil. It should be noted that almost the entire quantity of water falling in the form of snow eventually passes into the soil, because the time required to melt the snow generally exceeds one or two days, and if the material is not carried from the field by high winds some addition is made to the capillary water of the surface and subsurface area. The distribution for the period was as follows: January, 1896, 0.08 inch; January, 1897, 0.05 inch; December, 1897, 0.49 inch; December, 1898, 1.25 inches; January, 1899, 2.5 inches; February, 1899, 0.5 inch; March, 1899, 1.9 inches; December, 1899, 4.5 inches; January, 1900, 0.12 inch; February, 1900, 1.2 inches. The maximum snowfall for this period occurred in December, 1899. It should be observed that this precipitation was timely, inasmuch as the rainfall for the three subsequent months did not exceed 1.52 inches. In making a study of the average precipitation for this five-year period two or three facts should be noted. First, our maximum rainfall occurs during the month of May, while the minimum point is reached during the month of January. The average rainfall for November, December, January, and February is comparatively low.

TABLE II.—*Precipitation at the Oklahoma Agricultural Experiment Station for 1901 to 1905, inclusive.*

Month.	1901.	1902.	1903.	1904.	1905.	5-year average.	10-year average.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	0.62	0.13	0.25	1.03	1.79	0.76	0.94
February	.59	.17	2.19	.07	1.17	.84	1.02
March	2.95	5.03	3.66	.15	5.42	3.44	2.62
April	1.29	1.92	2.97	.80	2.80	1.96	2.71
May	4.70	10.86	9.27	7.28	4.86	7.39	6.55
June	.79	2.19	.78	6.54	3.76	2.80	3.71
July	1.48	2.85	3.47	5.18	3.19	3.23	3.82
August	1.95	2.17	2.48	7.42	3.15	4.48	3.51
September	1.11	4.64	3.01	1.66	2.88	2.56	2.89
October	2.11	.92	3.52	.13	2.88	1.91	2.56
November	.95	7.78	.55	.21	1.57	2.21	1.67
December	.90	1.63	.48	2.52	.62	1.23	1.24
Year	19.44	40.29	32.58	32.99	33.59	32.78	33.23

The snowfall for this five-year period stands as follows: February, 1901, 1.4 inches; December, 1901, 2 inches; January, 1902, 0.5 inch; December, 1902, 0.9 inch; February, 1903, 1.5 inches; February, 1904, 0.25 inch; November, 1904, 0.05 inch; December, 1904, 0.75 inch; February, 1905, 1.12 inches.

The annual average precipitation for the first five-year period was 33.9 inches, as compared with 32.78 inches for the second period, giving an average for the ten-year period of 33.23 inches. The average monthly precipitation for the years 1896–1900 reaches a maximum point during the month of May, while the lowest rainfall occurred in January. In our second table, which includes the years 1901–1905, the month of May shows the maximum precipitation for the five years, and the lowest point is reached during the same month as in the previous five-year period. The general results in the second period are practically the same as in the first. During the past two years there has been a marked increase in the rainfall for August, and this, with the rainfall for 1906, will have a tendency to raise the average for this part of the season. In general, our average precipitation runs low for the months of November, December, January, and February; then there is a gradual rise to the maximum point in the month of May, and subsequently the averages gradually decline until the end of October.

After making a careful study of these tables I have been led to reach the conclusion that there is a direct relation between the precipitation for this section and the recommendations which have been submitted by our station workers for the guidance of the farmers of the territory. For instance, the fall seeding of alfalfa has usually given more satisfactory results than spring seeding. As a matter of fact, crab-grass (*Panicum sanguinale*) gives less trouble in the fall-sown than in the spring-sown alfalfa, but there is still another reason

for the existing preference, and this is found in the fact that the heavy rainfall of the spring months has a decided tendency to wash our fields; hence, many of the young alfalfa plants are destroyed. If the field is plowed early in July and is given good treatment throughout the summer months, the soil will be in excellent condition for seeding the latter part of August or early in September. This plan also facilitates the storage of water within the soil, and the alfalfa plant has a full and continuous supply at hand throughout that period of the year when the rainfall is comparatively light.

Another illustration will serve to make this point somewhat clearer. The station at Stillwater has found that early (July) plowing for wheat gives better returns on the average than late (September) plowing. In this test the ground was plowed on or about July 15, August 15, and September 15 each year, and these plowings were designated "early," "medium," and "late," respectively. Duplicate plats were used in each case. The soil was turned to a depth of 7 to 8 inches and worked down immediately. Subsequently the plats were given light cultivation after each shower or heavy rain. The different areas were all drilled at the same time to Fulcaster wheat at the rate of 1½ bushels per acre. The time of seeding for the five years through which this experiment was carried ranged from September 15 to October 1. The yields are given in Table III.

TABLE III.—*Yields of wheat at Stillwater, Okla., from 1900 to 1904, inclusive, showing the effect of early, medium, and late plowing.*

Year.	Early plowing.		Medium plowing.		Late plowing.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush.	*Tons.*	*Bush.*	*Tons.*	*Bush.*	*Tons.*
1900	31.32	1.81	23.48	1.23	15.30	1.00
1901	43.60	1.99	38.20	1.74	40.20	1.92
1902	17.06	.63	18.15	.61	19.35	.81
1903	28.20	1.74	28.50	1.82	27.80	1.73
1904	15.25	.82	12.54	.56	7.51	.34
Average	27.10	1.39	24.20	1.19	22.00	1.15

In five years the early plowed plat produced a total of 135.5 bushels of grain and 6.99 tons of straw per acre; the medium plowing produced 120.7 bushels of grain, with 5.96 tons of straw, and the late plowing produced a total of 110.1 bushels of grain and 5.78 tons of straw. This makes a total difference in five years of 14.8 bushels of grain and 1.03 tons of straw in favor of the early plowing as compared with the medium plowing, and a total difference of 25.4 bushels of grain and 1.21 tons of straw in favor of early plowing as compared with late plowing. These results lead to the conclusions that better yields can be obtained by plowing early in the summer the land which is to be seeded to wheat. This means July 1 to August 15.

The same publication from which these results were copied states:

It should also be observed that these results were obtained on ground that was given good cultivation after early plowing. Early plowing alone will not suffice. The seed bed must be thoroughly prepared. On a great many farms the plowing is done at an early date, but the fields are allowed to remain in an open, broken condition until a few days before seeding commences, when the surface of the field is given a stroke with the harrow and the grain is drilled immediately. In the interval between the time of plowing and seeding the mechanical condition of the soil has not been improved. The fields become covered with weeds and moisture evaporates rapidly; consequently a poor seed bed and an imperfect germination result.[a]

If we had complete records of the moisture content of these plats during the progress of the experiment we would undoubtedly note an appreciable difference in the percentages shown for the respective treatments, especially during the more unfavorable seasons. If this is true, and we must concede the fact that our experimental data point in this direction, then in planning the rotation for this section some attention should be given to the monthly average precipitation, in order that we may be able to store a full supply of moisture for the growing crop. The different plants in use also consume varying amounts of water; hence, our plan should include a study of the moisture requirements of the crops in question. Our first principle may be resolved into a simple statement which reads thus: (1) The rotation should be so arranged that it will be possible to make the best use of our rainfall; and (2) it should not interfere with the needs of the subsequent crops so far as the moisture is concerned.

We come now to another phase of the subject. The tiller of the soil wishes to maintain the productive capacity of his soil; therefore, the arrangement prescribed must meet the food requirements of the plant if maximum yields are to be maintained. This was the idea which found a prominent position in the minds of those men who were instrumental in giving to the world some well-defined systems. The Norfolk four-course rotation may be mentioned as one of these. Turnips, barley, clover, and wheat were the crops which comprised the list. Coming down to a later date we find that our foremost agricultural investigators have emphasized the importance of maintaining the productive capacity of the soil; hence, they planned their work and made suggestions with this end in view. Permit me to offer another quotation from Sir Henry Gilbert:

Although different and sometimes very large amounts of these typical mineral constituents are taken up by the various crops constituting the rotation, there is no material export of any in the salable products except of phosphoric acid and potash; and so far, at least, as phosphoric acid is concerned, experience has shown that it may be advantageously supplied in purchased manures.

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[a] Bul. 65, Oklahoma Agricultural Experiment Station, "Wheat Growing."

But although the eventual loss to the land of mineral constituents is in a self-supporting rotation comparatively so small, the very fact that the different crops require for their growth not only very different amounts of individual constituents, but require these to be available within the soil in very different conditions, both of combination and of distribution, points to the conclusion that in any explanation of the benefits of an alternation of crops the position and the rôle of the mineral constituents must not be overlooked, and the less it can be when their connection with the very important element the nitrogen of the crops is considered.

Some agricultural writers of the past have insisted that a well-planned rotation aids in maintaining the fertility of the soil, but they have failed to include the statement that some return in the way of farm manure must be made if large crop yields are to be secured. Perhaps it would not be out of place to make a brief inquiry concerning the removal and ultimate distribution of the essential constituents of plant growth. It has been intimated that a rotation of crops offers a more satisfactory plan for the return of farm manure to the various fields, but the question of making a complete return was not discussed. This leads us to a study of the percentage of the elements which are found in a sample of average manure, and we shall also consider the amount of the mineral constituents which are taken from the soil by our staple crops.

Farm manure is made up of the liquid and solid excrements of the farm stock, together with the litter which has been employed. The term farm manure was formerly used to include all substances which were applied to the land for the purpose of enriching it. "Latterly the meaning of the word has changed somewhat, and it does not now embrace commercial fertilizers or those substances whose chief object is to improve the physical condition of the soil." Farm manure is sometimes called a "general manure," because it contains all the constituents of plant growth and it is likely to be generally useful in all soils. A knowledge of the composition of farm manure is essential to a proper understanding of the principles which have bearing not only upon the preservation of the material, but also in the application of the manure to the land. The composition of manure obtained from different sources varies in a great many cases to quite an extent, but in spite of this fact uniform results have been secured in many laboratories, and a few statements made will be based upon these results.

"Having regard to the more trustworthy of the analyses given in the tables, it will be seen that 100 pounds of good farm manure contains from 70 to 80-odd pounds of water, or say three-quarters of the weight of the whole manure, and it is safe to allow for each 100

pounds of the manure as much as four-tenths to six-tenths of a pound of potash, five-tenths to nine-tenths of a pound of lime, and about two-tenths of a pound of magnesia." In simple form the percentage of the essential elements present in the manure may be stated as follows: Nitrogen, .49 to .69 per cent; phosphorus, .06 to .15 per cent; and potassium, .33 to .49 per cent. If 10 tons of manure are applied to an acre of land once in three years, then 120 pounds of nitrogen, 30 pounds of phosphorus, and 98 pounds of potassium would be added to the soil. A three-year rotation of corn, wheat, and clover, where the crops approximate 100 bushels of grain for the corn, 40 bushels of grain for the wheat, and 3 tons of hay for the clover, removes 266 pounds of nitrogen, 38 pounds of phosphorus, and 120 pounds of potassium. According to this calculation, more plant food will be taken from the field in the grain and hay than is returned in the 10-ton application of average manure. The wheat, straw, and corn stover were not taken into account in this table. These figures serve to show, however, that although manure contains all the fertilizing elements, the quantity returned to the soil under average conditions is not sufficient to equal the amount which has been removed by the crops in question.

Farm manure has given good results when applied to Oklahoma soils, even in cases where continuous cropping is practiced, and we believe that still better returns can be secured in the application of this material to fields which are placed under a systematic course of cropping. In 1893 an acre of virgin soil was laid out for a continuous culture experiment with wheat. This plat was cropped to wheat annually, without the addition of manure or fertilizers of any kind, up to the summer of 1898, at which time the acre was divided into two sections of one-half acre each. One of these received an application of barnyard manure at the rate of 15 tons per acre in the fall of 1898 and another application at the rate of 11 tons per acre in the fall of 1899. This area received no further application of manure until the summer of 1904, at which time the plat was given a dressing of average, well-rotted, farmyard manure at the rate of 18 tons per acre. The manure, which was applied in July, was very moist, and it was therefore necessary to make a heavier application than would have been the case if the manure had been in ordinary condition. The remaining half of the original plat has received no manure or fertilizer whatever, but has been cropped continuously to wheat since the experiment started. Both plats have received the same cultural treatment, as follows: The plowing was invariably done in July, to a depth of 6 to 7 inches, and the soil was kept in a good state of tilth up to seeding time. The yields for an eight-year period are shown in Table IV.

TABLE IV.—*Yields of wheat on manured and unmanured plats in Oklahoma, 1899 to 1905, inclusive.*

Year.	Manured area.		Unmanured area.	
	Grain.	Straw.	Grain.	Straw.
	Bush.	*Tons.*	*Bush.*	*Tons.*
1899	30.60	2.76	12.00	1.31
1900	36.80	2.50	18.10	1.16
1901	37.70	1.43	28.00	....
1902	17.40	1.08	15.80	.74
1903	27.60	2.16	20.80	1.39
1904	15.70	.73	12.60	.57
1905	11.18	1.53	4.75	.55
1906	23.26	2.00	7.10	.72
Average	25.09	1.77	14.76	.99

In this field trial an average increase of 10.33 bushels per acre per annum was obtained by giving the treatment indicated. It is interesting to note that the average yield for the unmanured ground slightly exceeds the average yield for the Territory, according to the reports issued by the National Department of Agriculture.

If we refer again to our calculation on the losses due to cropping, we reach the conclusion that there is a marked deficiency with respect to the element nitrogen, and as no suggestions were made concerning methods of securing this constituent for the crop, your attention is directed to the following paragraph, which appears in Bulletin 74 of the Oklahoma Agricultural Experiment Station:

The cowpea and soy bean can not only be used to advantage in securing practical results in the management of farm crops, but the plants also serve a useful purpose from a fertility standpoint. These plants, as well as other members of the legume family, are able, through the medium of microscopic organisms which are found in small tubercles or nodules on the root systems, to assimilate free nitrogen from the soil air. This nitrogen is stored up within the plant in an organic form, and if the crop is used as a green manure the nitrogen in turn is rendered available for plant growth. Nitrogen is designated an essential element, and rightly so, because without this substance the plant or crop can not develop. In fields where the supply of nitrogen becomes deficient through the adoption of improper methods of soil management, the crop under average conditions does not make a normal growth; hence, in order to obtain maximum yields on such lands this element is frequently applied in some commercial form. The crop systems which are in vogue in the Southwest favor nitrogen exhaustion; thus, if the present plans are continued it will be but a short time until our lands will cease to return profitable yields. Nitrogen when purchased in commercial form is an expensive element, and if care and judgment are not exercised in the application of the fertilizer serious losses are likely to accrue. On the other hand, the use of legumes—and we speak more particularly of the cowpea and the soy bean—appears to offer a safe and satisfactory solution for the problem of nitrogen restoration. It should be observed that the necessary bacteria must be present in the soil in order to insure the development of tubercles on the roots. In this section the cowpea nodule-producing bacteria are normally present in

the soil, but the soy bean fails to produce tubercles on its root systems. Where the proper bacteria are wanting they can be supplied by obtaining samples of soil from a field where the germs are present and scattering the same on the uninoculated area.

These crops should be given a conspicuous position in our rotation. Inasmuch as the seasons in this section are comparatively long, the cowpeas and soy beans may be used as catch crops to follow wheat and spring grain. Alfalfa should be grown on the best land, and when a first-class set is obtained it will scarcely be profitable to replow the field for at least six or eight years. This plan throws one section of the farm out of the regular order of cropping, but it may be used in the rotation as soon as a second section is seeded to alfalfa.

There is another phase of this subject which should be considered. It has already been remarked that a given crop, Indian corn, makes a much better record in following a crop like potatoes or soy beans than in cases where it follows sorghum or Kafir corn. In the rotation, therefore, some attention should be given to these discriminations. Minnesota Station Bulletin 50 says: "Rotations were begun in 1894, and thus far potatoes followed by mangolds, corn, or field peas, wheat, and flax in the order given best prepared the land for the succeeding crop."

The Rhode Island Station Report for 1897 contains the following statements:

The average results for two seasons indicate that when potatoes are planted on a clover sod a better yield is obtained than when the crop is planted after corn. The growth of potatoes upon the clover sod plats was very rapid and vigorous, indicating the presence in the soil of considerable available nitrogen. Clover and lupines gave better results when grown after some other leguminous crops than when grown on a soil which had not produced a crop of that class for several years.

There is another item which may have a very important bearing in the arrangement of plans for the southern farmer. It is comprehended in the following statement in Louisiana Agricultural Experiment Station Bulletin 16, 2d series:

Several years ago the following rotation was decided upon as the best combination attainable in this section. This rotation is corn, oats followed by cowpeas, and cotton. This rotation is faulty in principle but correct in practice and was adopted last season after two years' trial. The corn should precede cotton, but experience has demonstrated that Red Rustproof oats, the only variety successfully grown here, must be planted in October if maximum results are desired. Cotton can not be removed in time for the crop, while corn can.

The rotation may be arranged in courses of any number of successive crops; thus, the farm can be divided into three, four, or five sections, and the form or plan best suited to the particular branch of agriculture in which we are engaged may be adopted.

The following is a good three-year rotation for northeastern Oklahoma: (1) Corn; (2) oats; (3) wheat followed by cowpeas. For the southeastern section of the State the three-year rotation may be as follows: (1) Corn; (2) oats followed by cowpeas; (3) cotton.

These rotations are arranged to meet the requirements of farmers. Farm manure can be applied to the respective fields prior to cropping the area with corn. If a spring variety of oats is used in each case, a catch crop of cowpeas might follow corn, although one could expect a reduction in the yield of corn by following such a method. The cowpea seed can be sown when the corn is "laid by." It will be seen that a winter variety of oats may be used to follow corn; hence, if better results can be secured by using such a variety than in the case of spring varieties, there will be sufficient time to prepare the land and sow the seed after removing the corn. This applies more particularly to southern sections of the State. In the cotton-growing sections a four-course rotation could be arranged by using the three crops included in No. 1. The cotton in this case would follow wheat, and the cowpea crop might be used to advantage for green manure to be turned under after the wheat is harvested.

The following is suggested as a suitable five-year rotation for farmers in central Oklahoma: (1) Corn; (2) kafir; (3) cotton; (4) oats; (5) wheat followed by soy beans. For northwestern Oklahoma the following is suggested: (1) Broom corn; (2) a legume crop; (3) wheat; (4) brome-grass; (5) brome-grass.

It may be stated in connection with the last of these five-year rotations that a legume like cowpeas can hardly precede wheat, provided the seed of the latter crop is sown in the autumn; but, if spring wheat (durum) is grown, such a plan will give satisfactory results. With winter wheat this combination would tend to exhaust the soil moisture and reduce the yield of wheat quite perceptibly. We are not in a position to state definitely whether brome-grass will thrive in the northwestern section, but, as it has given good results in Kansas and Nebraska, we have included the same in the five-year rotation suggested for northwestern counties. In the central and southern parts of the State brome-grass has never given very satisfactory results; consequently, this grass has not been recommended for those sections. Bermuda grass makes an excellent substitute, but it can not be manipulated as well in the rotation on account of its habits of growth. This grass is propagated mainly by scattering the roots in small furrows and covering them with a shallow layer of earth. Such a method requires considerable labor; hence, when a given area has been set to grass it is generally advisable to allow the same to remain down for a period of years. Alfalfa is also allowed to stand for a period of six or eight years. Farm manure can be applied to the

land in both of the five-year rotations suggested immediately preceding corn, or it may be incorporated with the soil early in the summer preceding wheat.

The following is suggested as a six-year course: (1) Corn; (2) oats followed by cowpeas; (3) kafir or sorghum; (4) cotton; (5) cowpeas (harvested); (6) wheat followed by soy beans. A five-year course of cropping followed by five years in alfalfa is suggested in the following: (1) Corn; (2) oats followed by cowpeas; (3) kafir or sorghum; (4) cowpeas or soy beans; (5) wheat; (6) alfalfa for five years.

These rotations are somewhat more extensive than the preceding. In both cases legumes are grown on three fields during a given season, and one could plan to use two of these crops for green manure provided the soil is deficient in humus. The stockman-farmer can use such crops to good advantage for feeding purposes, and then return the manure to the land. In the case of the last rotation given, the farm is divided into six fields, and five of these are subjected to an alternation of crops annually. At the end of the fifth year the alfalfa crop is moved to a new section, and the old alfalfa field is used in the yearly series. This plan presupposes that the entire farm is suitable for alfalfa. In planning a rotation the following facts should be taken into account:

(1) The rotation should be arranged to make the very best use of the annual rainfall.

(2) The productive capacity of the soil should be maintained; thus our crop system should be comprehensive enough to include provisions for the realization of this object.

(3) Various crops differ in their moisture capacities; consequently the rotation should be so arranged that one crop will not suffer because the preceding crop consumes an abnormal amount of moisture.

(4) It has also been stated that a given crop may do much better when preceded by a crop of potatoes than in cases where the land was previously devoted to a cereal. The likes and dislikes of the plant should be considered.

DRY-LAND PLANT BREEDING.

By J. H. SHEPPERD, *Director, North Dakota Agricultural Experiment Station, Fargo, N. Dak.*

The possibilities in dry-land plant breeding are so great that I feel that it will be a mistake not to enlist the side time of each scientific worker who comes in contact with plant life in the region.

Mendel, the Austrian monk, found time from his devotions to breed peas, and incidentally evolved one of the strongest hypotheses that the breeding world has ever received. Hugo De Vries, a Dutch botanist, found time to work upon scientific features of breeding and even to evolve a theory which has set the scientific world agog as to whether he has not more truly solved the question of the origin of species than did Charles Darwin.

The originators of the Concord grape and of the Wealthy apple are alike men who simply caught them up as side issues.

Light horses, poultry, dogs, pet stock, and flowers furnish more evidence of good sensible breeding than do any other classes of living domestic things, and they are simply the result, in a large part, of the side efforts of wealthy people.

You young men represent the only organized body of persons who are interested, in a broad and permanent sense, in the upbuilding of the dry-land region of the West. You are trained scientific men and you are brought in contact with large numbers of plants of the best-adapted sorts which the world can supply, and this enlarges your chance of happening upon the mutant of De Vries, the Concord grape, or the Justin Morgan of the light-horse world.

The climate makes you a strong and unbiased ally in selecting the Darwinian survival of the fittest for the Great Plains region.

Animal breeders hold that the success of Robert Bakewell and the many successful breeders of later generations in old England was due to the fact that live stock was bred so much by geographical districts, more commonly by counties, that the observing breeder by short horseback journeys could see hundreds to thousands of head of the particular breed and class in which he was interested and consequently could select the superior individuals, the result being that the world's breeds of domestic live stock, exclusive of swine, nearly all trace to the "tight little island." Do you not have a similar opportunity, with interested neighbors who are anxious to grow stock

of all the new things which you can recommend, who are glad to have you inspect their fields for prime specimens and who will, indeed, aid you in the task?

I am convinced that the Great Plains area has possibilities for producing crops of high quality which the balance of the country can not duplicate. It is a region noted for the clear air and intense sunlight. The fact that it is a dry-land country means more hours of sunshine than other portions of the country have, which, together with dry air, makes almost ideal natural disinfecting conditions. Absence of disease is certainly a great aid to the production of high quality. Dry ripening and curing weather are great aids in the production of high quality of crops, and I shall be surprised if the day does not come when the dry-land region will be looked to as the source of high quality in crop products.

Durum wheat, nonsaccharine sorghum, and several of the horticultural plants are sufficient indication that there are special types of plants particularly adapted to the dry-land region. The successful culture of slender wheat-grass (*Agropyrum tenerum*), Burbank's spineless cactus, and Hansen's native fruits indicates that foundation and acclimated stocks may be at your very doors if you will but guide nature's acclimated products into cultivated-plant channels. You are really engaged in a battle of conquest. You are at work upon a plan calculated to add territory to the profitable farming country. You are doing much by methods of moisture conservation and have much in prospect from that line and from the study of a sensible method of cropping, and it seems to me that it will be a fatal mistake not to take in this third ally—plant breeding—if not on an extended scale, certainly as a side line.

To those who go into plant breeding I would suggest two things: First, do not undertake too extensive a line of work; second, make sure to keep a plain, easily traceable record.

Interest in too many lines of breeding work will scatter your energies too much and force neglect. It is hard to throw away breeding stock, and especially when you have not worked it over thoroughly, as there is always the fear that you are throwing away the one which should be kept.

Keeping a record of plant-breeding stocks soon becomes a serious matter, as they rapidly run into large numbers and many generations. A plan of record keeping which would answer the needs, at least of those who practice plant breeding as a side line, is to indicate series by the letters of the alphabet and generations by figures.

One of the great needs of the dry-land region is the breeding of legumes, particularly clover and alfalfa; also the development of suitable grasses. In that work special provision will need to be

made to prevent your climate ally in selection from destroying your entire stock. Nature's selection is spasmodic, and during some seasons it is so severe as to eliminate good and bad alike. It is always wise to make provision for the future by saving a portion of your seed supply for a start during a second season. With the legumes and grasses at least two seasons' failure should be guarded against, for in addition to winterkilling there is the chance of a failure to secure a "catch" of plants which will be able to live through the trying times of the growing season.

I am convinced that there is great opportunity for improvement in the forage crops for the dry-land district, and particularly among the nonsaccharine sorghums, which can be selected and handled in much the same manner as corn breeding is done. Since they are annuals the chance of losing your entire improved stock of seed is much less than it would be with a biennial or perennial plant. They have individuality like corn, and hence are more easily handled in the nursery and in the pedigree record.

In closing let me urge that those employed at stations where the breeding work is not undertaken by a special man be upon the alert for the strong-constitutioned, vigorous, heavy-yielding, thrifty plant whose descendants are liable to be especially valuable. Those who come in contact with plants in large numbers have the chance to discover the Shakespeare of the species, and if De Vries's mutation theory is right it may be that a ready-made constant producer of a similar sort will be sighted. In any event it will prove an interesting line of study for the young man who gives it attention.

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 131.

B. T. GALLOWAY, *Chief of Bureau.*

MISCELLANEOUS PAPERS.

I. THE GERMINATION OF VEGETABLE SEEDS.

By EDGAR BROWN, *Botanist in Charge*, and WILLARD L. GOSS, *Assistant, Seed Laboratory.*

II. THE BOTANICAL HISTORY AND CLASSIFICATION OF ALFALFA.

By CARL S. SCOFIELD, *Agriculturist in Charge of Western Agricultural Extension Investigations.*

III. THE CROSS-INOCULATION OF FRUIT TREES AND SHRUBS WITH CROWN-GALL.

By GEORGE G. HEDGCOCK, *Scientific Assistant, Investigations of Diseases of Fruits.*

IV. RECENT STUDIES OF THE OLIVE-TUBERCLE ORGANISM.

By ERWIN F. SMITH, *Pathologist in Charge of the Laboratory of Plant Pathology.*

V. THE NECTARIES OF COTTON.

By FREDERICK J. TYLER, *Scientific Assistant, Fiber Plant Investigations.*

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[a] The five papers constituting this bulletin were issued in separate form on March 7, March 14, March 16, May 13, and July 6, 1908, respectively.

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B. P. I.—385.

MISCELLANEOUS PAPERS.

B. P. I.—351.

THE GERMINATION OF VEGETABLE SEEDS.

By Edgar Brown, *Botanist in Charge of Seed Laboratory*, and Willard L. Goss, *Assistant, Seed Laboratory*.

INTRODUCTION.

There is doubtless no more remunerative form of agricultural labor than that employed in caring for the kitchen garden, or home vegetable garden, and none which contributes so largely to the comfort and happiness of the family. From an educational standpoint the kitchen garden is even more important. It is here that country children have the opportunity to turn their exertions to practical use, and here that they first get an intimate acquaintance with plant life and its relations to agriculture.

On account of both the practical value of the kitchen garden and the stimulating effect it has on the children who care for it, the seeds that are sown should be the best. Most of these gardens are planted with seeds purchased in packets from the local store. These seeds, known in the trade as "commission" seeds, are put up in fancy-colored papers in display boxes and sent to local stores to be sold on commission, those unsold being returned at the end of the season. It is easy to see that this system may lead to abuse, and the results of an examination of a large number of samples of these seeds show that many seedsmen rely more on the striking appearance of the colored packets than on the quality of their contents.

GERMINATION TESTS.

During the spring of 1907 there were purchased in the States of Maine, Vermont, Massachusetts, Kentucky, Wisconsin, North Dakota, Kansas, and Colorado 2,778 packets of so-called "commission" vegetable seeds. These were put up by 27 seedsmen and included seeds of 26 kinds of vegetables. In Table I is shown the average germination of each kind of seed sold by each of these seed-packeting houses, as well as the average germination of each kind from all the houses, the average germination of all the kinds from each house, and the average germination of all the samples.

TABLE I.—*Average germination of "commission" vegetable seeds tested in 1907.*

[The figures in parentheses show the number of packets of seed tested in each case.]

Number assigned each seed-packeting house.	Bean.	Lima bean.	Cabbage.	Carrot.	Cauliflower.	Sweet corn.	Cress.	Cucumber.	Kale.	Kohl-rabi.	Leek.	Lettuce.	Muskmelon.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1	(1) 36	.....	(5) 58.6	(3) 26	.....	(2) 75.5	(1) 0	(4) 56	.....	.....	.....	(3) 75.3	.....
2	(6) 96.6	(1) 90	(7) 85.4	(1) 45	(2) 64.5	(7) 80.8	.....	(3) 81	.....	.....	.....	(8) 96.1	(5) 62.2
3	(2) 96.5	.....	(9) 46.3	(4) 52.2	.....	(2) 75	(1) 29	(6) 62.5	.....	.....	.....	(5) 76.4	(2) 31
4	(2) 98	.....	(4) 46.2	(1) 55	.....	.....	.....	(3) 73.3	.....	.....	.....	(2) 73	.....
5	.....	.....	(2) 55.5	(1) 64	.....	.....	(1) 98	(4) 79	.....	.....	.....	(2) 73.5	.....
6	(8) 67.6	.....	(34) 21.8	(10) 30.1	(2) 26	(1) 63	(2) 45	(12) 65.8	(3) 22.7	(2) 4	(2) 12	(21) 72.3	(11) 28.9
7	.....	.....	(11) 67.1	(4) 54.7	(1) 69	.....	.....	(7) 76	.....	.....	.....	(9) 88.7	(4) 74.5
8	(6) 89.9	(1) 100	(18) 33.2	(3) 26	(1) 60	(4) 56	.....	(9) 70.2	(1) 0	(2) 63.5	(2) 54	(9) 66.8	(2) 17
9	.....	.....	(8) 31.5	(5) 21.6	.....	.....	(2) 87.5	(17) 66.2	(1) 59	.....	(2) 51	(13) 73.4	(2) 64
10	.....	.....	(7) 75.4	(2) 56	.....	.....	(1) 79	(7) 90.7	.....	.....	.....	(5) 77.8	(2) 86
11	(13) 92.4	(1) 75	(77) 73.1	(35) 57.6	(9) 73	(3) 85.3	.....	(41) 67.4	(9) 60.3	(5) 71	(7) 47.8	(51) 88.5	(25) 78.8
12	(2) 98.5	(1) 96	.....	.....	.....	(1) 95	.....	(1) 96	.....	.....	.....	(3) 95.3	(1) 82
13	(2) 73.5	.....	(1) 90	(1) 87	(2) 53.5	(2) 76.5	.....	(3) 83	.....	(1) 97	.....	(3) 82	(2) 88
14	.....	.....	(4) 30	(2) 41.5	.....	.....	(1) 64	(4) 44.5	(1) 13	(1) 45	.....	(6) 42.5	(3) 31
15	.....	.....	(6) 53	(4) 49.2	.....	.....	(1) 44	(8) 72.1	.....	.....	.....	(5) 79.4	(2) 37.5
16	(16) 80.6	(4) 91.2	(32) 32.5	(9) 30.9	(5) 47.6	(17) 55.8	.....	(21) 70.3	(2) 47.5	(1) 3	(2) 17.5	(20) 71.9	(6) 42.2
17	(5) 60.8	.....	(12) 12.5	(8) 25.4	.....	(5) 84.2	.....	(13) 55.1	.....	(2) 39	(2) 22	(14) 42	(5) 47
18	.....	.....	(1) 10	.....	(1) 0	.....	.....	(1) 95	.....	.....	.....	(1) 60	.....
19	.....	.....	(6) 63.5	(3) 42.7	(2) 75.5	.....	(1) 94	(6) 85.2	(3) 46.6	(1) 76	(1) 50	(6) 91.3	(3) 60.7
20	(3) 95.3	(1) 95	(4) 63.2	.....	.....	.....	.....	(3) 81	.....	.....	.....	(2) 75.5	.....
21	(2) 95.5	.....	(6) 65.5	(4) 45.2	.....	(4) 72.5	(1) 98	(5) 83.6	(1) 66	(1) 91	(1) 72	(3) 98	(2) 93
22	(3) 93.7	.....	(1) 71	(4) 44	.....	.....	.....	(1) 85	.....	.....	.....	(6) 68.2	(1) 97
23	.....	.....	(5) 62.4	(3) 58.3	.....	.....	.....	(6) 74.2	.....	.....	.....	(6) 90.2	(1) 90
24	(18) 87.2	(1) 94	(58) 47	(20) 48.1	(5) 52.8	(12) 81.8	(2) 52.5	(39) 60.3	.....	.....	.....	(40) 71.5	(16) 61.5
25	.....	.....	(11) 66.3	(6) 54.8	.....	.....	(2) 86	(11) 79.8	.....	.....	.....	(10) 90.5	(2) 53
26	.....	.....	(1) 80	.....	.....	.....	.....	(4) 76.7	.....	.....	.....	(3) 66	.....
27	(9) 81.1	(1) 92	(1) 81	(2) 69.5	(1) 85	(5) 83.6	.....	(5) 86.4	.....	(1) 84	.....	(4) 82.2	.....
Average of each kind for all packeting houses	(98) 84.9	(11) 91.5	(331) 50.8	(135) 45.4	(31) 56.3	(65) 73.9	(16) 65.5	(244) 69.7	(21) 46.9	(11) 56	(19) 40.5	(260) 76.7	(97) 61.1

Table I.—*Average germination of "commission" vegetable seeds tested in 1907*—Cont'd.

[The figures in parentheses show the number of packets of seed tested in each case.]

Number assigned each seed-packeting house.	Onion.	Parsnip.	Pea.	Pepper.	Pumpkin.	Radish.	Ruta-bags.	Salsify.	Spinach.	Squash.	Tomato.	Turnip.	Watermelon.	Average of all kinds for each packeting house.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
1	(2) 42.5	(2) 1	(2) 65	.....	(1) 8	(2) 78.5	(3) 52	.....	(1) 54	(5) 34.6	(2) 64	(3) 33.7	.....	(42) 47.7
2	(3) 64	.....	(4) 94.2	(3) 81.3	(6) 73.7	(3) 87	(1) 98	(2) 42	.....	(6) 88.5	(6) 83.8	(2) 96.5	(5) 72.4	(81) 81.7
3	(4) 28.5	(1) 6	(1) 80	.....	.....	(8) 69.2	(2) 44	(1) 2	(1) 44	(3) 60.3	(2) 57	(2) 58.5	(2) 64	(58) 55.9
4	(1) 15	(1) 4	(3) 70.3	.....	.....	(2) 75	.....	.....	.....	.....	(2) 87	(1) 99	.....	(22) 68
5	(1) 65	(1) 75	.....	.....	(1) 84	(1) 98	(1) 75	(1) 0	.....	(1) 60	(2) 86	.....	.....	(19) 71.8
6	(14) 12.8	(4) 1.2	(1) 84	(6) 27	.....	(32) 50.1	(7) 21	(4) 17.5	(2) 65.5	(19) 55.7	(10) 78.8	(15) 68.6	(19) 47.3	(241) 44.3
7	(4) 61	(1) 16	.....	.....	.....	(5) 70.8	(3) 89	.....	(2) 79.5	(7) 83.7	(8) 64.4	(3) 85.7	(3) 78.5	(72) 73.4
8	(5) 26	(7) 7.3	(5) 83.2	.....	.....	(16) 73	(2) 11	(1) 0	(1) 43	(5) 22	(8) 52.6	(5) 39.6	(2) 48	(115) 50
9	(4) 55	(2) 10.5	.....	.....	.....	(11) 66	(4) 55	.....	.....	(8) 68.6	(5) 67.6	(4) 80.7	(3) 72.8	(91) 60.6
10	(2) 35	(2) 15.5	.....	.....	(1) 84	(4) 94	.....	.....	.....	(4) 69.2	(3) 83.7	(1) 29	(2) 85.5	(43) 75
11	(33) 74.3	(17) 30.7	(10) 88.1	(10) 30.3	.....	(56) 79.9	(8) 93.1	(9) 43.2	(5) 76	(36) 66.5	(49) 77.7	(44) 92.7	(45) 74.4	(598) 73.7
12	.....	(1) 38	(2) 83	.....	.....	(5) 60.6	.....	.....	(1) 51	(4) 78.7	.....	(1) 95	.....	(23) 79.1
13	.....	.....	(3) 60.7	(1) 71	(2) 76	(4) 78	.....	.....	.....	(1) 90	.....	(1) 79	(2) 91	(31) 78.1
14	(3) 59.7	(2) 29.5	.....	(1) 47	.....	(5) 66.2	(3) 31.6	.....	(2) 63.5	(3) 42	(3) 49.3	(4) 77.7	(3) 15.3	(51) 45.5
15	(2) 85	(1) 66	.....	.....	.....	(6) 94	(1) 41	(1) 15	(1) 78	(5) 72	(4) 77	(3) 81.7	(3) 64	(53) 68.8
16	(10) 25.7	(7) 6.1	(14) 56.8	(2) 43.5	(6) 55.9	(27) 69.5	(2) 24.5	(2) 48.5	(1) 12	(15) 64.7	(16) 56.6	(12) 26	(5) 46.4	(259) 53
17	(4) 8.5	(2) 26.5	.....	(3) 3	.....	(13) 52.4	(3) 24.6	(2) 1	(2) 39.5	(9) 27.8	(6) 49.5	(7) 27.8	(4) 25.5	(121) 37.3
18	(1) 74	(1) 36	.....	(1) 32	(1) 72	.....	.....	(1) 6	.....	.....	(1) 89	.....	(1) 76	(11) 50
19	(5) 73.8	(1) 2	.....	(2) 3.5	.....	(9) 90.5	(2) 81	(1) 14	(1) 66	(2) 18	(4) 83	(3) 92	(5) 63.6	(67) 69.5
20	(2) 76.5	.....	.....	.....	.....	.....	.....	.....	.....	(1) 82	.....	(2) 59.5	.....	(18) 76.8
21	(6) 52.7	(2) 46.5	(3) 94.6	(2) 9.5	.....	(6) 92.7	(1) 91	(1) 72	.....	(2) 84	(4) 77.5	(2) 100	(2) 89.5	(61) 74.9
22	(4) 3.7	(1) 13	(1) 72	(1) 31	.....	(1) 96	(1) 18	(1) 29	.....	(1) 0	(1) 84	(1) 75	(1) 86	(30) 54.6
23	(4) 50	(1) 59	.....	(1) 36	(1) 32	(10) 92.9	(1) 78	(1) 77	(1) 82	(2) 44	(1) 79	(2) 77.5	(1) 68	(47) 73.3
24	(21) 38.1	(8) 18.2	(18) 77.2	(12) 33	.....	(50) 64.7	(9) 81.6	(6) 19	(2) 64	(39) 53.9	(27) 58.2	(43) 62.8	(24) 58.8	(470) 58.8
25	(4) 22.3	(2) 26.5	.....	.....	(2) 79	(8) 67.9	(1) 71	.....	(2) 63	(8) 76.3	(5) 53.2	(7) 72.1	(2) 90	(83) 68.9
26	(1) 49	(1) 0	.....	.....	.....	(7) 61.3	.....	.....	.....	.....	(2) 61.5	(2) 97	.....	(21) 65.7
27	(1) 75	(1) 42	(4) 95	(2) 60	.....	(2) 80	(1) 99	(1) 4	(1) 65	(3) 71.7	(2) 96.5	(3) 64.3	.....	(50) 78.7
Average of each kind for all packeting houses.	(141) 45	(69) 20.8	(76) 74.4	(47) 33.7	(21) 63.9	(293) 71.3	(56) 58.6	(35) 27	(26) 62	(189) 59.8	(173) 69	(173) 69.9	(134) 64	(2,778) 62.2

The germination of many kinds of seed was surprisingly low. The average germination of the 135 samples of carrot seed tested was 45.4 per cent; of the 141 samples of onion seed, 45 per cent; of the 331 samples of cabbage seed, 40.8 per cent; of the 47 samples of pepper seed, 33.7 per cent; of the 35 samples of salsify seed, 27 per cent; while of the 69 samples of parsnip seed, only 20.8 per cent germinated.

The seed from certain packeting houses was especially poor. Of 121 packets put up by one seedsman, the average germination was only 37.3 per cent, and of 241 packets put up by another the average germination was 44.3 per cent. In many cases wide differences in germination were found between different packets from the same seedsman, as shown in Table II.

TABLE II.—*Comparison of the highest and lowest percentages of germination of lettuce seed packeted by several firms for sale on commission.*

Number assigned each seed-packeting house.	Highest germination.	Lowest germination.	Difference.	Number assigned each seed-packeting house.	Highest germination.	Lowest germination.	Difference.
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	*Per cent.*
6	95	5	90	16	99	0	99
8	99	2	97	17	89	0	89
9	100	17	83	22	100	2	98
11	100	20	80	24	100	19	81

Of 200 packets from 21 of the 27 packeting houses referred to, none germinated more than 10 per cent, while all the seed in 62 packets from 13 firms failed to germinate.

It is evident that some seedsmen are not ignorant of the quality of the seed they are selling. In the case of one firm, whose packets bear private distinguishing marks, the following differences in the average germination were found between packets bearing one mark and those bearing another mark:

TABLE III.—*Variation in germination of "commission" vegetable seed put up by one seed-packeting house.*

Kind of seed.	Packets bearing private mark No. 1.		Packets bearing private mark No. 2.		Difference in average germination.
	Number tested.	Average germination.	Number tested.	Average germination.	
		Per cent.		*Per cent.*	*Per cent.*
Lettuce	27	97	24	79	18
Cabbage	28	87	49	65	22

"COMMISSION" SEEDS COMPARED WITH THOSE SENT OUT IN THE CONGRESSIONAL SEED DISTRIBUTION.

In view of some criticisms of the quality of the seeds sent out in the Congressional seed distribution, the following table (Table IV) is

presented, showing the average germination of the various kinds of commission seeds tested in comparison with the average germination of the same kinds of seeds distributed by the Department of Agriculture on Congressional orders during the past six years.

TABLE IV.—*Comparison of "commission" seeds with those sent out in the Congressional seed distribution.*

Kind of seed.	Average germination for six years of seeds sent out on Congressional orders.	Average germination of "commission" seeds tested.	Difference.	Kind of seed.	Average germination for six years of seeds sent out on Congressional orders.	Average germination of "commission" seeds tested.	Difference.
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	*Per cent.*
Beans	96	84.4	11.6	Pea	93	74.4	18.6
Lima beans	96	91.5	4.5	Pepper	67	33.7	33.3
Cabbage	88	50.8	37.2	Radish	96	71.3	24.7
Carrot	75	45.4	29.6	Spinach	83	62	21
Sweet corn	86	73.9	12.1	Squash	92	59.8	32.2
Cucumber	89	69.7	19.3	Tomato	86	69	17
Kale	85	46.9	38.1	Turnip	94	69.9	24.1
Lettuce	95	76.7	18.3	Watermelon	87	64	23
Muskmelon	89	61.1	27.9				
Onion	86	45	41	General average	87.3	61.6	25.7
Parsnip	77	20.8	56.2				

In all cases the average germination of the "commission" seeds tested was lower than that of those sent out in the Congressional seed distribution, varying from 4.5 per cent for Lima beans to 56.2 per cent for parsnips.

That many firms are selling vegetable seeds not only of a low average quality but often entirely worthless makes it evident that some sort of protection should be afforded the purchaser by a guaranty of quality given by the seedsman.

SUMMARY.

"Commission" seeds are largely used in planting kitchen gardens, and should be of good quality.

The quality of such seeds is poor, the average germination of 2,778 packets of 26 kinds from 27 seed-packeting houses being only 62.2 per cent.

The average germination of seeds from one firm was only 37.3 per cent, and from another 44.3 per cent.

The variation in germination of different packets of the same kind of seed from the same firm was in several cases more than 90 per cent.

By 21 of the 27 seedsmen whose seed was tested, 200 lots of seed were put up which germinated 10 per cent or less.

By 13 packeting houses 62 lots of seed were put up which entirely failed to germinate.

The average germination of the "commission" seeds tested was 25.7 per cent lower than that of those sent out in the Congressional seed distribution during the past six years.

The purchaser should receive some sort of guaranty as to the quality of the seeds he is buying.

B. P. I.—348.

THE BOTANICAL HISTORY AND CLASSIFICATION OF ALFALFA.

By Carl S. Scofield, *Agriculturist in Charge of Western Agricultural Extension Investigations.*

INTRODUCTION.

The genus of plants to which alfalfa belongs contains a large number of species and is of great agricultural importance, since it includes, besides alfalfa, a number of promising species as yet little known. The genus includes two groups of species that are very distinct from an agricultural standpoint. The first and more important is the group of erect perennials of the alfalfa type. The other consists of species that are prostrate or spreading in habit of growth; nearly all of these are annuals. This latter group includes the so-called bur clovers, which are valuable as range plants in the West and Southwest and are used also for early spring pasture along the coast of the Gulf of Mexico.

During a trip made by the writer to Algeria in the spring of 1901, opportunity was afforded for a comparative study of some of the species of this genus, a large number of which are indigenous to North Africa. In attempting to identify the various Algerian species, the literature of the group has been examined, and as a result it seems certain that a complete revision will be necessary before these species can be correctly identified and their relationships properly understood. Such a revision is now in progress, but since its early completion is not practicable and since it will necessitate a change in the botanical name of alfalfa, it seems proper to give a brief statement regarding the botanical history and classification of that plant.

THE ORIGIN OF THE ALFALFA PLANT AND OF ITS COMMON NAMES.

The forage plant popularly known in America as alfalfa, or lucern, is generally believed to be of Asiatic origin, but the record of the first domestication and earliest use of the plant is vague. It was apparently well established in agriculture before the earliest records of Greek history, but whether it was first domesticated by the Persians,

as the Greeks supposed, or was used earlier by people farther east is not known.

As is the case with many other domesticated plants, there is much uncertainty as to the identity of the wild species from which the present cultivated species is descended. In fact, the botanical name was first given to the domesticated plant and has never been associated with any wild species.

The early Persian name[a] of the plant has not come down to us, but the Romans, who learned of it and its culture from the Greeks, accepted both the Greek name and the account of the introduction of the plant into Greece from Persia, which is said to have occurred at the time of the Persian invasion, about 490 B. C. Thus the names "Medike," by which the plant was known to the Greeks, and "Herba Medica," by which it was known to the Romans, refer to its Persian or Median origin. It was highly prized as a forage crop, especially by the Romans, and is frequently mentioned by their writers on agriculture and natural history as early as the beginning of the Christian era. Some time early in the Middle Ages it came to be known popularly under the name "luzerne" (spelled also "luserne," "lucerne," and "lucern"), which was probably derived from the name of a river valley in northern Italy, in the western Piedmont country.[b]

Alfalfa was undoubtedly known and cultivated as a forage plant in northern Africa nearly or quite as early as it was known in Italy, but whether the culture was carried into Africa by the Romans or whether it was brought westward direct from Asia is not clear. The Arab invasion which swept across northern Africa and into southwestern Europe in the seventh century seems to have carried the culture of the plant and the Arabic name with it into Spain, so that at about the time the southern Europeans were beginning to know the plant as "luzerne" the North African and Spanish people, under Arabic and Moorish influence, were calling it by the name "alfalfa," or "alfacfacah," which in the Arabic language means "the best kind of fodder."

With the discovery and colonization of America the English and West European colonists brought the plant and the name "lucern" to eastern North America, while the Spanish colonists carried the same plant, under the name "alfalfa," to Mexico and South America.

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[a] There is some difference of opinion as to what was the prevailing Persian name, but the most generally accepted view is that it was "aspest," signifying "horse fodder."

[b] De Candolle, in his Origin of Cultivated Plants, 2d ed., 1886, p. 103, prefers to trace the derivation of the name "lucern" from an old Spanish name, *eruye*, thence through the Catalonian name *userdas* to "the patois name in the south of France, *laouzerdo*, nearly akin to *luzerne*." This evidence, however, does not seem sufficient to justify the acceptance of the more devious rather than the more direct derivation.

Until very recently the name "lucern" has been the more popular in the eastern United States, and it was even carried as far west as Utah by the Mormon pioneers in the middle of the nineteenth century, where it still persists in common use.

The culture of the plant from the European introduction did not prosper in the eastern United States and it has never secured a very important place in eastern agriculture. It was found to be well adapted to many places in Central and South America, however, and its culture and the name "alfalfa" spread together very rapidly throughout that part of the hemisphere. The plant was also carried northward by Spanish settlers along the Pacific coast to California, where it has become the most important forage plant of the region. More recently it has been spread through the Eastern States again, until now it is known and cultivated to some extent in every State in the Union, and at the present time the Arabic-Spanish name alfalfa has almost entirely replaced the European name lucern.

THE EARLY SCIENTIFIC NAME.

The history of the technical name of alfalfa is much more complicated than that of the common name. The earliest botanists apparently accepted the common Latin name "Medica" for the plant, and when similar and apparently related plants were discovered the same name was given them, with the addition of other distinguishing and descriptive terms, according to the custom that prevailed previous to the promulgation of the binomial system of nomenclature by Linnæus in 1753. In the year 1700 Tournefort, the noted French botanist, published in his Institutiones Rei Herbariæ, under the group name Medica, a list of these descriptive names for alfalfa and its related species. Two of these species were illustrated in the upper half of plate 231, a reproduction of which is shown in figure 1. In the same work is described a plant, a native of southern Europe, to which the name Medicago is given, because, as Tournefort said, it resembles Medica,[a] and this plant is illustrated in the lower half of the plate mentioned.

THE CONFUSION OF GENERIC NAMES.

In the first edition of his Systema Naturæ, published in 1735, Linnæus, following the earlier writers, applied the name Medica to alfalfa and its related species, and as he then evidently regarded the Medicago of Tournefort as congeneric with alfalfa he used the name Medicago as a synonym of Medica. In his Species Plantarum, published in 1753, the standing of these names was reversed without

[a] "Medicago, id est planta ad Medicam accedens." Tournefort, 1700, Inst. Herb., p. 412, pl. 231.

comment or explanation, the name Medicago being applied to the genus and the name Medica being reduced to a synonym.[a] Alfalfa

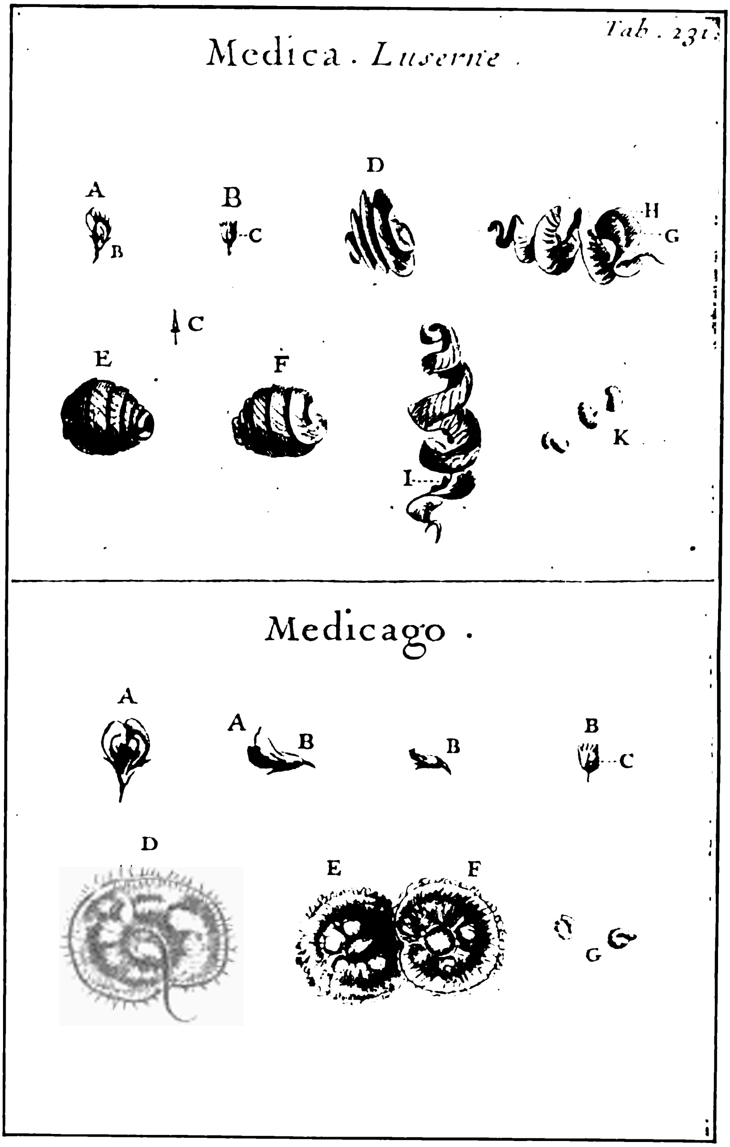

FIG. 1.—Tournefort's plate 231, illustrating flowers, fruits, and seeds of Medica and Medicago. (This illustration is cited by Linnæus in his Genera Plantarum, 1754, as the basis of the genus Medicago.)

was given the name *Medicago sativa*, and the species described and figured by Tournefort under the name Medicago was called

[a] It is quite probable that Linnæus made this change of name to avoid the use of a simple adjective as a generic name.

Medicago radiata. Practically all botanists since have followed the classification of Linnæus so far as alfalfa is concerned, and alfalfa is now generally known by its Linnæan name, *Medicago sativa.*

THE TYPE OF THE GENUS MEDICAGO.

The generic name Medicago as used by Linnæus, when typified according to the accepted rules of nomenclature, is based on the Medicago of Tournefort, which is the *Medicago radiata* of Linnæus. This plant can not properly be regarded as congeneric with alfalfa. The similarity noted by Tournefort and accepted by Linnæus is merely superficial. This fact becomes apparent if the seeds of the two species are compared (see fig. 2, *a* and *c*). Since *Medicago radiata* is comparatively rare and little known, the great dissimilarity between it and alfalfa was not appreciated by botanists until 1841, when Trautvetter attempted to remedy matters by transferring *Medicago radiata* to the genus Pocockia. This was done apparently without knowledge of, or at least without considering, the fact that the name Medicago was first given to this species and that it was therefore the type of the genus.

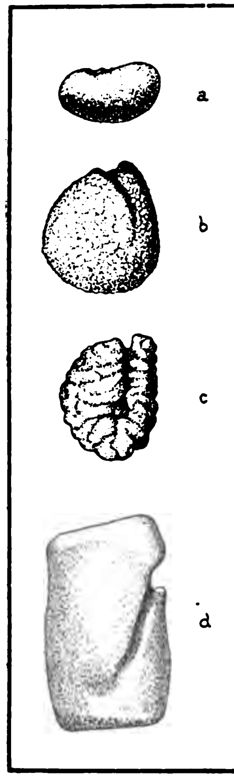

FIG. 2.—Seeds typical of alfalfa and related genera; *a*, seed of alfalfa, *Medica sativa; b*, bur clover, *Medicago orbicularis; c, Medicago radiata; d, Trigonella foenum-graecum.* (Magnified 6 diameters.)

The genus Pocockia was erected by Seringe in 1825,[a] but was reduced from generic rank by Bentham and Hooker in 1865.[b] The name has since been applied to a section of the genus Trigonella. The new binomial, *Trigonella radiata,* was published by Boissier in 1872,[c] since which date the type of the genus Medicago has not been included in that genus.

THE TYPE OF THE GENUS MEDICA.

Since the name Medicago can not properly be applied to alfalfa, it remains to trace out the proper generic name. The earliest post-Linnæan author to treat of this group of plants is Dr. John Hill, whose British Herbal was published in 1756.

[a] De Candolle, 1825, Prod. Syst. Nat. Veg., vol. 2, p. 185.
[b] Bentham and Hooker, 1865, Genera Plantarum, vol. 1, p. 487.
[c] Boissier, 1872, Fl. Orient., vol. 2, p. 90.

Hill used the name Medica[a] for the genus, and referred to the earlier publication by Linnæus, saying, "He alters the name, writing it Medicago." While Hill did not use the binomial system of nomenclature, his first species is associable by citation with a previously published binomial. The species which Hill calls *Medica sylvestris flore flavo*, the "Yellow Medick, with flat, wreathed pods," is without doubt the *Medicago falcata* of Linnæus. It is listed by Hill as the first of the British species, and is also the first of the several species illustrated on the plate cited. Hill's citation for this species is: "C. Bauhine calls it *Trifolium luteum sylvestre lignea sive frutescens*." Linnæus's citation [b] under the name *Medicago falcata* is given in slightly different form, "*Trifolium sylvestre luteum, siliqua cornuta. Bauh. pin.* 330"; but it can apply to no other of Bauhin's species. The exact wording of Bauhin's description is[c] "*Trifolium syl. luteum siliqua cornuta, vel Medica frutescens.*" It seems proper, therefore, to credit Hill with the first post-Linnæan publication of the generic name Medica and to treat the *Medicago falcata* of Linnæus as the type of the genus.

Adanson[d] also used the name Medica rather than Medicago, making Medicago a synonym. This author, however, was dealing only with families and genera, and did not enumerate the species of Medica.

The first publication in which the name Medica was used in direct connection with binomial species is the eighth edition of the Gardener's Dictionary, by Philip Miller.[e] This author, like Hill, called attention to the change of names by Linnæus, and said:

> This genus of plants is ranged in the third section of Linnæus's seventeenth class, which includes the herbs with a butterfly flower, having ten stamina in two houses. He also has joined the Medica and Medicago of Tournefort together, making them one genus under the title Medicago, but Tournefort makes the distinguishing character of Medicago to consist in having a falcated compressed pod. Therefore I shall here separate those plants whose pods are of that form from the others whose pods are twisted like a screw; and as the title of Medica was first applied to the Lucern, so I shall continue it to those species as have such pods, and refer the others to the genus of Medicago.

Notwithstanding his evident appreciation of the generic differences recognized by Tournefort, Miller proceeded to complicate the situation still more in his distribution of species to the two genera. In the genus Medica he lists in the following order: *Medica sativa, Medica falcata, Medica radiata, Medica hispanica, Medica italica,*

[a] Hill, 1756, British Herbal, p. 311, pl. 45.
[b] Linnæus, 1753, Species Plantarum, vol. 2, p. 779.
[c] Bauhin, 1623, Pin., p. 330.
[d] Adanson, 1763, Familles des Plantes, p. 325.
[e] Miller, 1768, Gardener's Dictionary, not paged.

Medica cretica, and *Medica arborea*. The first species has "pods that are twisted like a screw," while the others, with the possible exception of *Medica italica*, of which the identity is in doubt, have "falcated compressed" pods. Furthermore, his *Medica falcata* and *Medica arborea* are certainly congeneric with *Medica sativa*, while his *Medica radiata* and *Medica cretica* are species of true Medicago. His *Medica hispanica*, the *Medicago circinnata* of Linnæus, is now known as *Circinus circinatus* (L.) Kuntze.

In the genus Medicago, Miller lists the following species: *Medicago marina*, *Medicago scutellata*, *Medicago tornato* (sic), *Medicago intortexta* (sic), and *Medicago laciniata*, all of which have "pods that are twisted like a screw" instead of "a falcated compressed pod." This grouping of the species was both illogical and incorrect and may have been in part the reason that later botanists chose to follow Linnæus rather than Miller in the use of these names.

It will be seen from the foregoing that the generic name Medica as used by Hill is based on the plant known as *Medicago falcata* L. This Linnæan name is not valid because, as will be shown later, that plant is not congeneric with the type of the genus Medicago. Hill must be recognized, therefore, as the author of the genus name Medica and Miller as the author of *Medica falcata*, the name of the type of that genus, and of *Medica sativa*, the correct name of alfalfa.

THE SEED CHARACTERS OF ALFALFA AND RELATED GENERA.

The seed characters of Medica and the related genera are sufficiently distinct and striking to aid materially in understanding the generic differences. The seed of *Medica sativa*, which is the best known species of the genus Medica, is shown in figure 2, *a*. It is kidney shaped, 2 mm. to 2.5 mm. long, with considerable variation in outline. The seed coat is nearly or quite smooth, with the radicle extending half the length of the cotyledons, or a little more, and with the line between the radicle and the cotyledons scarcely distinguishable. There is also considerable variation in the color, which ranges from a dull yellow, sometimes tinged with green, to a reddish brown.

The seed of the type species, *Medica falcata*, is similar to that of *Medica sativa*, but is slightly larger, averaging nearly 2.5 mm. in length. The radicle is proportionately longer and more distinct, and the color is usually brighter, ranging from a pale yellow to light brown.

The seed of *Medicago radiata* (fig. 2, *c*) is slightly less than 3 mm. long, dark reddish brown in color, the radicle equaling or even exceeding the cotyledons in length, and the seed coat is very rough and transversely wrinkled even when the seed is plump. It may be

observed that the seed of this species is well illustrated in Tournefort's plate (see fig. 1).

It should be noted in this connection that the seed of *Medicago orbicularis* (fig. 2, *b*) resembles that of *Medicago radiata* rather than that of *Medica sativa*. This species, *Medicago orbicularis*, is the only true Medicago which has not been transferred by botanists to another genus. This is probably due to the fact that in general appearance and habit of growth this species is not sufficiently different from some of the other so-called "bur clovers" to attract attention. A close examination of the seed, however, leaves no doubt that this species is congeneric with *Medicago radiata* rather than with *Medica falcata*.

Since the *Medicago radiata* of Linnæus has been placed by all recent botanists in the genus Trigonella, a seed of *Trigonella foenum-graecum*, the type of that genus, is also shown (fig. 2, *d*). The seed of this species is relatively large, 4 to 5 mm. long, subcylindric, obliquely truncate in outline, dull yellow to brownish red in color, with the seed coat nearly smooth and the radicle very prominent and about two-thirds as long as the cotyledons.

The seeds of these three groups are thus seen to be strikingly different, and so far as known there are no intergradations between them with respect to these characters. In view of these facts it seems necessary to recognize three genera to include the species hitherto grouped under the generic names Medicago and Trigonella.

ANALYTICAL KEY TO THE GENERA.

Pod cylindrical, straight or hooked, with a long, attenuated beak; seeds subcylindric or compressed, the ends obliquely truncate by mutual pressure. Genus *Trigonella* (Tournefort) Linnæus; type, *T. foenum-graecum* Linnæus.

Pod flattened, sickle shaped or twisted into a spiral, abruptly short pointed; seed kidney shaped or orbicular.

- Seed kidney shaped, about twice as long as broad, the surface smooth; radicle about half the length of the cotyledons. Genus *Medica* (Tournefort) Hill; type, *M. falcata* (Linnæus) Miller.
- Seed suborbicular or oval, very little longer than broad; surface rough, punctate, tuberculate, or wrinkled; radicle as long as or longer than the cotyledons. Genus *Medicago* (Tournefort) Linnæus; type, *M. radiata* Linnæus.

SUMMARY.

Alfalfa has been cultivated as a forage crop since very ancient times. It was brought into Greece by the Persians about 490 B. C. Its culture spread westward on both sides of the Mediterranean and later to both American continents, where it is now widely distributed. It was known to the Greeks and Romans as "Medike" and "Herba Medica" on account of its supposed Median origin. Its common

English and European name, lucern, is probably derived from the name of the valley of the Luzerne River, in northern Italy. Its common Spanish and American name, alfalfa, is derived from an Arabic word, "alfacfacah," meaning "the best kind of fodder."

The prevalent botanical name of alfalfa, *Medicago sativa*, can not properly be used for this plant, since the name Medicago belongs to another plant not congeneric with alfalfa. The plant which was described under the name Medicago and to which that name properly belongs has been recently known to a majority of botanists as *Trigonella radiata*. The correct botanical name of alfalfa is *Medica sativa* (L.) Mill.

B. P. I —350.

THE CROSS-INOCULATION OF FRUIT TREES AND SHRUBS WITH CROWN-GALL.[a]

By GEORGE G. HEDGCOCK, *Scientific Assistant, Investigations of Diseases of Fruits.*

INTRODUCTION.

In another publication[b] brief mention has been made by the writer of the identity of the forms of disease known as crown-gall occurring upon the almond, apricot, blackberry, cherry, peach, plum, prune, chestnut, and walnut. This identity has been fully established by subsequent experiments with nearly 5,000 seedlings grown in sterilized soil, watered with sterile water, and inoculated in wounds with pieces of gall from the outer portions of galls taken from plants of the kinds mentioned.

In addition to these experiments, later and more extensive experiments with apple and pear seedlings carried on both in the field and the greenhouse with 15,000 carefully selected seedlings inoculated similarly with galls from the almond, apricot, blackberry, cherry, peach, plum, and rose gave results indicating that the soft galls occurring on the apple, pear, and rose are also forms of the same disease. Smith and Townsend[c] have shown that galls on peach trees can be produced by inoculations with pure cultures of *Bacterium tumefaciens* Sm. & Town., the cause of the formation of the galls on the Paris daisy. Coupling this fact with the results of the writer's experiments, it is possibie that the soft galls of these plants with which he has experimented are caused either by the same organism or by closely related forms.

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[a] The recent discovery of the bacterial nature of the crown-gall of peach trees and certain other plants clears up in a considerable measure the doubt regarding this important disease. The experiments here briefly described by Doctor Hedgcock were carried out before the cause of the disease was known, and are important in showing the extent to which cross-infection ordinarily takes place from one variety of plants to another. It is believed that the results are of sufficient practical as well as scientific importance to warrant their publication in this brief preliminary note.—B. T. GALLOWAY, *Pathologist and Physiologist and Chief of Bureau.*

[b] Science, n. s., vol. 22, pp. 120, 121, July, 1905.

[c] Science, n. s., vol. 25, pp. 671-673, April, 1907.

EXPERIMENTS WITH CROWN-GALL.

Many of the writer's experiments with the soft form of crown-gall on apple and pear seedlings have given negative results. These experiments were usually small in extent. The results from three of the larger experiments are presented here.

In the most extensive experiments with the apple, healthy seedlings were carefully washed and divided into four lots of approximately the same number. The plants of one set were wounded by making a downward, slanting incision into the root, and then the wound was wrapped with thread in the same manner that grafts are wrapped, to be used as a control. A second control set was treated similarly, except that a chip or piece of clean, healthy apple root was inserted in the wound before wrapping. A third set was prepared like the first, except that a piece of soft apple gall was inserted in the wound. A fourth set was prepared similarly, except that a piece of hard apple gall was inserted. The seedlings in this and the following experiments were prepared, planted, and grown under the personal direction and observation of the writer. The trees were dug after growing one season, with the following results.

Of 977 trees grown in the first control, wounded only, 1.4 per cent were diseased with crown-gall, chiefly of the hard form; of 920 trees in the second control, with healthy chips in the wounds, 1.5 per cent were similarly diseased; of the set of 851 trees inoculated with soft gall, 10.9 per cent were diseased with galls of the soft form and 2 per cent with those of the hard form; of the set of 821 trees inoculated with galls of the hard form, 2.1 per cent were diseased with galls, principally of the hard form.

These results, in the writer's opinion, show quite conclusively that apple crown-gall in its soft form is contagious, but that in the hard form it is either slightly or not at all contagious. Should it be shown later that the two forms are results of infection by the same organism it will probably follow in the case of the hard form that the apple tree has been able to resist and largely overcome the effect of the parasite by healing processes which lower its vitality. That such may be the case is shown by the results from several large experiments with grafted apple trees where the percentage of galls on nursery trees decreased rapidly for three years.

Another experiment carried out similarly with healthy apple seedlings resulted as follows: Of the control set in which the trees were wounded only, 0.8 per cent of 657 trees were diseased with galls, chiefly of the hard form; of the control set of 672 trees with inserted healthy chips, 1.2 per cent were similarly diseased; of 627 trees inoculated with chips of dead peach gall, 3.1 per cent were diseased with galls, nearly all of the soft form; of 640 trees inoculated with

chips of dead raspberry gall, 3.3 per cent were similarly diseased; of 605 plants inoculated with chips of live rose gall, 3.5 per cent were diseased as before. Although the percentage of infection in this experiment is very low, the soft galls produced by the inoculations were so typical of those which occur on stone fruits and roses, even to the rotting away of numbers of them at the close of the growing season, that it is very evident that the disease is the same on the apple as on the stone fruits where the galls have the soft form.

In a third experiment 1,600 healthy pear seedlings were prepared, planted, and grown as in the former experiments, inoculations being made with chips of gall from the following plants: Almond, blackberry, cherry, peach, raspberry, and rose. Galls from a number of other plants were used with negative results, but those named gave positive results, as follows: Of the control in which the trees were wounded only, none was diseased with galls; of the control in which the trees were inoculated with healthy chips, 1 per cent was diseased with galls, about half being of the soft form; of the trees inoculated with almond gall, 4.2 per cent were diseased with soft galls. The other sets showed the percentages of plants diseased with soft galls to be as follows: Blackberry galls, 9.5 per cent; raspberry galls, 6.6 per cent; peach galls, 7.8 per cent; rose galls, 15.8 per cent. These positive results prove that the soft galls of the pear are identical with those of the stone fruits and the raspberry, the blackberry, and the rose.

SUMMARY.

From the results obtained by five years' experimentation in the greenhouse with seedlings grown under carefully regulated conditions, the following facts are noted:

The soft galls from the almond, apricot, blackberry, cherry, peach, plum, prune, and raspberry have been transferred easily to seedlings of the almond, apricot, peach, and raspberry; less readily to those of the blackberry, cherry, plum, prune, and pear; and with great difficulty to seedlings of the apple, chestnut, walnut, and rose.

The soft galls of the apple, chestnut, walnut, rose, and pear, as a rule, have not been transferred readily to any of the plants mentioned. Evidence has been obtained of a wide range of susceptibility in different varieties of the same plant. This has been noted in varieties of the apple, blackberry, cherry, chestnut, pear, and rose.

RECENT STUDIES OF THE OLIVE-TUBERCLE ORGANISM.

By Erwin F. Smith, *Pathologist in Charge of the Laboratory of Plant Pathology.*

INTRODUCTION.

In recent years the olive orchards of California have suffered considerably from swellings on the branches, known as olive tubercles and attributed to bacteria. This disease was first described in Italy, at least in modern times, albeit imperfectly as regards its cause. It has been known since Roman days.

DEPARTMENT EXPERIMENTS.

A desire to learn the natural methods of infection and the exact biology of the organism in the hope that this might bring to light some method of coping with the disease led the writer, in 1903, to begin a systematic study of the olive tubercle, which has continued to date, material being obtained from California and subsequently from Italy. Mr. James Birch Rorer was associated with the writer in the earlier work.

The right organism was plated out of the tumors without difficulty and determined to be a schizomycete. Numerous inoculations by needle puncture were made on sound olive trees in one of the hothouses of the Department of Agriculture with very satisfactory results. During this study it was learned that a yellow schizomycete, perhaps more than one, quite frequently accompanies or follows the parasite, and that occasionally nonpathogenic white bacteria also occur in the tumors. These yellow and white organisms were determined to be nonpathogenic by needle-puncture inoculations. All of the inoculations were made on young growing shoots of the olive. No fungi were found in the tubercles used for the poured-plate isolations, but subsequently fungi were found in some of the old tumors.

During this year (1903) tumors were produced on about 50 olive plants by pure-culture inoculations (on every one inoculated), and with pure cultures plated therefrom a second crop of knots was produced, thus complying with Koch's rules of proof. Many control

punctures on the same plants healed promptly. During the entire seven months only one accidental infection occurred, and this one could be accounted for satisfactorily, i. e., it appeared lower down on a branch already inoculated and forming a tumor. Such being the results, no reasonable doubt remained as to the possibility of producing the tumor with pure cultures of bacteria, nor from our studies was there any doubt as to the particular organism involved. Our experiments fully confirmed Savastano's statements respecting the bacterial origin of the tumor, but the parasite was white, not yellow as stated in literature. These facts were set forth in December, 1903, in an address before the Society for Plant Morphology and Physiology, illustrated by stereopticon and by inoculated plants, an abstract of the same being published in Science.

During the four years which have elapsed since this preliminary note, many additional successful inoculations have been made (the total number of inoculations now exceeding 500), and occasional accidental infections have also appeared on the experimental olives, all of the plants being in one place from the start. These latter, however, have been comparatively few and in no way confusing. About 150 olive plants of several varieties were used for these experiments. They were rooted cuttings from sound plants which had been grown in one of the hothouses of the Department of Agriculture for many years.

OTHER RESEARCHES.

About the same time as the writer, Ruggero Schiff, subsequently known as Schiff-Giorgini, began experimenting on the olive tubercle in Italy. His first paper was published in German in 1904. This was followed in 1905 by a second paper in German and by a longer paper in Italian, wherein he furnished additional evidence of the same character as that given in his first paper. Doctor Schiff claimed to have obtained successful infections with a schizomycete totally different from that isolated in our laboratory. He also stated that cultures of the *Bacillus oleae* are flocculated or agglutinated by juice from tubercles, but not by juice from sound parts of the plant. Fortunately, he described his organism so carefully that no doubt remains as to exactly what he meant by it.

In 1905 the writer called attention to the discrepancy between his own and Schiff's studies, stating some of the points of disagreement, and venturing the statement that no olive knots could be produced with pure cultures of Schiff's organism.

About this time Dr. Amedeo Berlese, an Italian, became interested in knots on olive trees; distinguished, incorrectly it would seem, two distinct forms of tubercle; and cultivated from the ordinary form a yellow organism, inclined to orange, supposed by him to be *Bacillus oleae*

(Arc.) Trevisan, and from the other form a white organism said by Petri to be Schiff's bacillus.

Moreover, in 1905, Peglion, in Italy, described a tubercle from the oleander, noted its anatomical resemblance to the olive tubercle, isolated a schizomycete therefrom, with characters like *Bacillus oleae* (Arc.), and made inoculations, but did not wait for results before publishing. This organism, isolated by Peglion, is unlike the olive-tubercle organism, and in Doctor Petri's experiments and our own, a culture of it having been given me by Doctor Petri, also proved non-pathogenic to the oleander.

In 1906 Clayton O. Smith, of California, also described the oleander tubercle, cultivated a schizomycete therefrom, secured inoculations on oleander and olive, and definitely identified the organism as *Bacillus oleae* (Arc.) Trevisan, the growth of this organism on potato being described as spreading, raised, and always straw colored. Peglion's work is not mentioned.

One of Doctor Schiff's colleagues, Dr. Lionelle Petri, assistant to Doctor Cuboni in Rome, took up the subject in 1905, by this time a rather confused one. After experimenting for a period of two years he published a paper in German in 1907, in which he states that both Schiff-Giorgini and Berlese are wrong, the only infectious organism of the three studied by him being that isolated and described by Smith in 1905. The *Bacillus oleae* (Arc.) Trevisan is a mixture. On agar both elements of this mixture may remain alive for some time, or one may destroy the other.

INOCULATIONS WITH SCHIFF'S BACILLUS.

My note of 1905 in the Centralblatt did not cover all my knowledge of the olive tubercle. I included in this note only enough to show that Schiff-Giorgini and myself were experimenting with entirely different organisms and that probably both of us could not be right. I had not then experimented with his organism, but I assumed that Schiff was wrong because we had produced fine examples of the olive tumor repeatedly (50 of them in 1903 and a great many since) with my organism, while he passed over the etiology of his organism with a few inconclusive remarks, to wit:

> It is unnecessary to dwell on the pathogenicity of *B. oleae;* it has already been demonstrated by others, as I said above in speaking of the work already extant on this subject. In addition I will say that I have repeatedly caused the tuberculosis in healthy olive plants, using pure cultures of *B. oleae* in glycerinated broth.

This is all Schiff has to say on inoculation experiments in his paper of 28 quarto pages. In the earlier German papers he barely mentions the subject. I did not consider Berlese's note of any importance, because he did not confirm his statements by successful inoculations.

At the time of my note to the Centralblatt in 1905, I had not seen Schiff-Giorgini's organism, but I obtained it toward the end of 1905 from Kràl, who had it from Kornauth, and made inoculations with it on olive shoots in 1905 and 1906.

All of these inoculations failed, although they were several times repeated, for the most part on young, actively growing shoots, using young cultures and inoculating very copiously with needle pricks on varieties of olives very sensitive to the knot. Altogether about 50 inoculations in three series (including 500 or more punctures) were made with this organism at considerable intervals during a period of about two years, using slant-agar for the first lot, potato cultures for the second, and slant-agar for the third. Not a single tumor developed. In one or two cases only there was a slight swelling in the pricked area such as check punctures sometimes give, but none of these developed into knots, and they were only slight cicatrization elevations. Bacteria were present at the end of a year in some of these punctures, as determined by a microscopic examination of sections. Possibly these slight wound reactions are what Schiff-Giorgini identified as tubercles, for he states that he obtained the disease with "pure cultures" of his organism repeatedly (ripetutamente); or it may be that his inoculation experiments were made with mixed cultures (they were fluid cultures at any rate); or, finally, it may be that they were made on limbs of olives already infected with the tubercle organism and ready to develop tumors. Tubercles on olive trees being more easily observable, if they had been present, than mixtures of bacteria in his fluid cultures, the second supposition is probably the correct one, since Schiff says that the olive trees used were sound ones and that the inoculations were from "glycerinated broth." My twelve olive plants were under examination for many months, and in some instances, especially in the final inoculations, a much greater amount of Schiff's organism was inserted than it has ever been my custom to use in the case of the true tumor-producing organism.

I can therefore confirm Doctor Petri's statement respecting this organism, my own inoculation experiments being perfectly in accord with his. The Schiff-Giorgini organism, which has various well-marked characteristics and is not likely to be mistaken for any other organism peculiar to the olive tree, is not the cause of the olive tubercle, and Schiff's conclusions, therefore, as to immunity, resistance, agglutination, etc., can not be accepted.

There can be no doubt, I think, that I had Schiff-Giorgini's organism, since, except in some slight details likely to vary from culture to culture and person to person, it corresponded perfectly with his own very full description, as I took care to find out before making many

inoculations. Kràl wrote to Schiff for it, who said he did not have it any longer, but perhaps Professor Kornauth would still have it, as proved to be the case.

AGGLUTINATION TEST.

The writer repeated the agglutination test described by Schiff, using young bouillon cultures of the right organism and the juice of a fresh large knot mixed with barely sufficient water to enable one to filter it satisfactorily through a Chamberland bougie. The peptone was thrown out of solution by this fluid, but the bacteria continued separate and motile; they were not in any way clumped by one or two hours exposure or even by exposure over night, nor when one part of the bacterial fluid was put into as much as ten parts of the juice and examined in a hanging drop. Moreover, even if Schiff had had the right organism, twenty to forty hours is altogether too long to wait for an agglutination.

SAPROPHYTIC BACTERIA IN TUBERCLES.

I find it difficult to believe that Schiff-Giorgini's organism occurs in all natural olive knots or that there is any symbiotic relationship. As already stated, saprophytic bacteria frequently occur in olive tubercles, and Doctor Petri touches on the possibility of symbiosis, without, however, committing himself to it. My original belief was that Schiff must have obtained his organism from the surface of an imperfectly sterilized potato culture or from the surface of the olive tubercle, but from Doctor Petri's observations we must now conclude that it occurs in the interior of some of the tubercles. The yellow organisms called *Ascobacterium luteum* by Doctor Petri may occur in all old knots, since we may assume them to be common on the surface of olive trees, just as certain nonpathogenic forms are common on the skin of animals, but they are not by any means always in young knots. In certain poured plates where I found yellow bacteria in conjunction with the right organism I had good reason to think the surface of the tubercle had been insufficiently sterilized (thirty seconds). Neither Schiff's organism nor the yellow form isolated by Berlese is necessary for the production of the tubercle, as Doctor Petri has also shown. In Petri-dish poured plates made from olive tubercles collected in autumn and winter, or in early spring before new growth has commenced, probably also in late summer, one might expect to find various intruding bacteria, also fungi. I have found the bacteria very frequently, especially the yellow ones. Schiff's organism I have not, so far, found in the tubercles. In two instances I have obtained only the nonpathogenic yellow organisms from olive tubercles, but these were at least 6 or 8 months old, and perhaps older—too old

anyway. One lot came from Naples and the other from Tunis. Schiff's mistake arose from the belief that anything found in the tubercle must necessarily be the cause of it. That he did not discover and correct his mistake later on is due to the fact that his inoculations were not properly controlled.

NOMENCLATURE OF THE OLIVE-TUBERCLE ORGANISM.

The nomenclatorial vicissitudes in connection with the olive-tubercle organism may be stated as follows:

1886. *Bacterium oleae* Arcangeli: Bacteria seen in cavities in the tubercles and name given without measurements or any description, except the statement that they resembled *Bact. termo*. The cavities also contained mycelium and spores. No bacteriological studies were made. Statement hazarded that the bacteria had nothing to do with the production of the tubercles which arise in wounds. The tubercles were described quite carefully and attributed to physiological disturbances favored by special predisposition.

1889. *Bacillus oleae tuberculosis* Savastano: Studies begun in 1886; tubercles produced in 1887 and again in 1889 with cultures of bacteria obtained from the knots. Organism described as a motile short rod, which is whitish or yellow on culture media and sometimes liquefies gelatin, while at other times it does not.

1889. *Bacillus Prillieuxianus* Trevisan: A name based on Prillieux's account of the disease and given without study or proper description.

1889. *Bacillus oleae* (Arc.) Trevisan: A simple transfer to another genus. The description is borrowed (curtailed) from Savastano. *B. Prillieuxianus* is placed under it as a synonym; also *B. oleae tuberculosis*.

1904–1905. *Bacillus oleae,* the cause of olive tubercle, stated by Schiff-Giorgini to be a white to dirty yellow, polymorphic, peritrichiate bacillus, producing spores very readily, forming long chains and tangled threads suggestive of the anthrax organism, producing a prompt pellicle on bouillon, liquefying gelatin, coagulating milk, growing readily at 37° C., withstanding a temperature of 102° C., etc.

1905. The olive-tubercle organism stated by Erwin F. Smith to be a white, nonsporiferous, nonliquefying organism, consisting of short rods, motile by means of polar flagella, unable to grow at 37° C., killed by a temperature of 50° C., incapable of coagulating milk, etc. Yellow and white nonpathogenic bacteria stated to occur in the tubercles.

1907. *Bacillus oleae* (Arc.) Trevisan, stated by Petri to be a "Sammelname," which splits up on study into *Bacillus oleae* α (Smith), the

true parasite; *Bacillus oleae* β (Schiff-Giorgini), a nonpathogenic organism; and *Bacillus oleae* γ, which in Berlese's cultures is *Ascobacterium luteum*, a nonpathogenic, liquefying peritrichiate form, and in Savastano's cultures is *A. luteum*, mixed with Smith's organism, an assumption believed to be required by the fact that Savastano describes his organism as sometimes liquefying gelatin and as yellow on some media and yet obtained tubercles on making inoculations.

Such being the situation, by what name shall the olive-tubercle organism be known?

The earliest name, Arcangeli's, is practically a nomen nudum, since the description accompanying it does not presuppose pathogenicity nor enable anyone to determine what organism was intended. Arcangeli's entire description is as follows:

> But I constantly found between the irregular cavities placed more or less deeply (whose walls were oftentimes more or less chestnut colored and changed) colonies of a bacterial form like *Bacterium termo*, which I shall call *Bacterium oleae*, together with mycelial filaments, possibly of a Cladosporium, and spores of fungi.

Savastano was the first man to isolate bacteria from the olive tubercle and to secure infections. His name is the next earliest, but it is a trinomial, and a part of his description is drawn from mixed cultures. The organism does not liquefy gelatin and is not yellow.

Trevisan's names are inadmissible because he merely copied earlier vague statements and no one can tell from his descriptions what organism was intended. This is shown admirably by the very diverse interpretations which have followed, e. g., Berlese's and Schiff's. Indeed, the subject is in such confusion that in recent years no less than four distinct organisms have been considered to be *Bacillus oleae* by different writers.

After careful consideration, to avoid further confusion, the writer has decided to give an entirely new name to the organism isolated by himself, and, in order that Savastano may not fail of due honor, he has decided upon the name *Bacterium Savastanoi*, with the following characterization:

DESCRIPTION OF THE OLIVE-TUBERCLE ORGANISM.

Bacterium Savastanoi (nov. nom., nov. descript.)

Synonym (pro parte): *Bacillus oleae tuberculosis* Savastano.

Names of doubtful import, to be rejected: *Bacterium oleae* Arc.; *Bacillus Prillieuxianus* Trev.; *Bacillus oleae* (Arc.) Trev.

Latin diagnosis.—Baculis cylindricis apicibus rotundatis, longitudine variantibus, solitariis vel in filamentis brevibus dispositis; baculis unis saepe 1.2–3$\times$0.4–0.8 μ; se moventibus, aerobiis, asporis.

Hab.: In tumoribus Oleae europeae. Coloniae in gelatina tenues, albae, marginibus inaequales, nonliquefacientes. Coloniae in agar-agar albae, rotundae, nitentes, evolventes lente (in extremo die septimo 2–5 mm. latae). Culturae in tuberibus Solani primo albae, dein pallidae fulvae-albae sunt. Lac sterile alcalinum fit et casein nonsegregatur. Baculi methodo Gram noncolorantur. Nitrum nonredigitur. Acidum in mediis cum saccharo uvae celeriter fit. Si culturae novae in infusione carnis ¼ horam in temperatura 50° C. tenentur, moriuntur. Inter temperaturam 35° C. et temperaturam 1° C. crescit. Inoculatum in Oleas sanas, tumores proprios producit.

A white, nonliquefying schizomycete, causing olive tubercle. This organism is found in the olive tubercle and in many culture media as a short rod with rounded ends, either single or in pairs, growing end to end, or in small clumps, more rarely in short chains; the rods taken from the interior of an unruptured tubercle measured 1.5 to 3 $\times$ 0.6 to 0.8 μ when stained by carbol-fuchsin and washed in water; the rods from young agar cultures stained with carbol-fuchsin usually measure about 1.2 to 1.5 $\times$ 0.5 μ; rods from 3 days' old colonies on agar measured 1.2 to 2 $\times$ 0.4 μ when stained by a modified Gram, i. e., washed in amyl alcohol, and cleared in xylol; more rarely they are 10 μ or more in length; in bouillon kept for three days at 30° C. the thinly clouded fluid examined in hanging drops contained numerous actively motile rods five to twenty-five times as long as broad, some of the long rods plainly constricted in the middle, others not, the long ones flexuous;[a] the organism is motile by means of one to several polar flagella, often 2 to 4 (Pitfield's flagella stain), the rods so stained being 2 to 5 $\times$ 0.6 to 0.8 μ.

Young motile agar cultures stain readily with carbol-fuchsin, but not by Gram; the organism is aërobic and very sensitive to heat; the growth is white in various culture media (bouillon, peptone water, milk, standard agar, sugar agars, gelatin (especially at bottom of slant), silicate jelly, starch jelly, Cohn's solution, Fermi's solution, Uschinsky's solution); on +15 nutrient agar in poured plates made from bouillon and incubated at 20° C. or 25° C., the surface colonies are small, circular, smooth, glistening (internal structure reticular), rather slow growing, appearing at the end of the second and third days and best observed after three to four days, becoming denser and whiter with age;[b] the intruders usually come up first in plates made

[a] In a repetition made in 1908 the same result was obtained: The longest single rods were 3 μ; the chains varied from 6 to 40 μ; some of the chains were actively motile.

[b] In +15 standard nutrient agar in Petri-dish poured plates made recently and kept at 22° to 23° C. the surface colonies in thin-sown plates were pure white, rather slow growing (1.5 to 3 mm. at the end of the third day), round, flat, surface smooth, glistening, edge entire or nearly so, internal structure under the compound microscope amorphous to finely granular; buried colonies quite small. At the end of seven days

from the tubercles, and often the right colonies are then best observed after four to six days; bouillon is thinly clouded, and there is finally a small amount of white precipitate—in four days at 20° C., no rim, pellicle, or flocculence; on peptone water a white pellicle after some

the surface colonies were 2 to 5 mm. in diameter and more or less viscid, the slime sometimes stringing up 1 cm., the margin was undulate and there was often a ring. In another set of agar plates made some days later and studied with equal care, the surface colonies were 0.7 to 1.3 mm. in diameter after forty-eight hours at 23° C. The margin was entire. The surface was wet-shining and smooth. The internal structure under the hand lens was reticular. Under the compound microscope it was amorphous to finely granular. The buried colonies were small biconvex. At the end of seven days the surface colonies were white, circular, ringed or not. The surface was smooth and wet; the internal reticulations were still visible under the hand lens. Under the 16 mm. and 12 ocular the colonies were finely granular.

In +10 gelatin poured plates made at the same time, the surface colonies were 1.5 to 2.5 mm. in diameter at the end of four days at 21° C. They were white, slow-growing, round, flat, with undulate, erose, paler white margins, and fine internal striæ. There was no liquefaction. After some weeks the margins were decidedly lobed.

On gelatin the marginal growth is quite characteristic and distinct from the body of the growth, both in colonies and in streaks. The edges of the streaks and colonies are often more or less lobate or incised. Savastano observed this and likened the appearance to that of a leaf. Whenever the slime runs down from the streak it is seen to be white, but often the growth on gelatin is so thin that the yellow color of the gelatin shows through and might thus lead to confusion.

Often after some days a brownish stain is produced on potato and in the fluid and this modifies the color of the bacterial growth, but it can scarcely be called yellow; perhaps tawny or tawny-white comes nearest to describing it. A similar color occurred in the older zoogloeæ forming the rim of two flask cultures containing river water, calcium carbonate, Witte's peptone, and grape sugar.

In undisturbed test-tube cultures in water containing 2 per cent Witte's peptone, a thin white surface membrane forms after some days (five or six) and falls readily as a unit, being broken up only by rather vigorous shaking.

Two water solutions of copper sulphate were prepared, i. e., 1:100,000 and 1:500,000. One-half cubic centimeter of a young, thinly clouded bouillon culture was pipetted into 10 c. c. of each one of these two coppered waters. Checks were held by pipetting one-half cubic centimeter of the same bouillon culture into each of two tubes containing 10 c. c. of pure water. Petri-dish poured plates were made with carefully measured quantities of the fluid at the end of one-half hour, one hour, two hours, and twenty-four hours. Check plates from the pure water dilutions were also made at the end of two hours and twenty-four hours. In all 36 plates were poured (three of each coppered water at each date and 12 check plates). Result: No distinct reduction in colonies by one-half hour, one hour, or two hours exposure; marked reduction after exposure for twenty-four hours. In the 1:100,000 solution *four-fifths* of the bacteria were destroyed. There was also a similar marked reduction in the weaker solution of 1:500,000. The colonies on the plates made from the coppered waters came up a day sooner than those on the check plates, the growth of those bacteria that survived being stimulated. By using a young bouillon culture rather than washings from an agar streak it was believed that the advantage would be in favor of the bacteria, since we may suppose some part of the copper would be rendered inert by the organic matter of the bouillon.

days; it blues litmus milk, the fluid, which is lavender or lilac on the start, becoming gradually a deep blue; it does not form acids in milk and does not coagulate milk by a lab ferment; it grows readily in Cohn's solution and for a long time, producing an abundance of crystals of ammonium magnesium phosphate, no difficulty being experienced in obtaining enough for a chemical analysis from small flask cultures; in old gelatin streaks and in old gelatin stab cultures there was a thin white surface layer, but no trace of liquefaction, growth along the line of the stabs was not well developed; in gelatin streaks and gelatin colonies there is an irregular undulatory lobed or incised margin; organism nonsporiferous, nonliquefying, nongas forming; growth on cooked potato at the end of two days was smooth, white, wet-shining, distinct, but not very copious, cylinder slightly grayed and fluid at the bottom moderately cloudy, the growth at first on potato being not unlike the pure white growth of *Bacillus tracheiphilus*, even in old cultures the growth is never a decided yellow (see footnote); potato cultures eighteen days old gave a deep purplish blue reaction when mashed in iodin water, the checks giving a bright blue color, i. e., the organism acts but slightly on potato starch; action on olive starch unknown; it does not reduce nitrates in peptonized beef bouillon; it will not grow in beef bouillon at 38.5° C., and is killed in +15 standard beef bouillon by exposure in the water bath, in test tubes, for ten minutes at 50° C.; streak cultures on litmus agars containing filtered river water and Witte's peptone, but free from beef juice, behave as follows:

Plain litmus agar.—This becomes blue and remains so (forty days), growth moderate.

Litmus dextrose agar.—This reddens promptly (twenty-four hours, at 27° C.) and decidedly, and remains acid indefinitely (color bright red—not purple), growth slight.

Litmus galactose agar.—This reddens promptly and decidedly and remains acid (forty days); same reaction as with litmus dextrose agar, growth moderate.

Litmus saccharose agar.—This remains neutral or nearly so for some days, finally, however, becoming purplish and then purple-red; growth stimulated, i. e., a much greater volume of bacterial slime than on the other agars and the litmus reduced in the bottom of the tube after some days.

Litmus lactose agar.—This blues; growth not more than on the plain litmus agar; no acid was formed (thirty days).

Litmus maltose agar.—This blues, growth moderate; no acid was formed (thirty days), and there was no reduction.

Litmus mannit agar.—This blues, growth moderate, after ten days litmus purplish, never red.

Litmus glycerin agar.—This remains neutral or nearly so, i. e., in nine days only a trace of purpling and no marked increase of red in next twenty days, good growth.

The most striking reaction is the prompt complete reddening of the litmus in the presence of dextrose or galactose and its persistency.

A slight indol reaction (pink color) was obtained with sodium nitrite and sulphuric acid both in peptone water and in Uschinsky's solution with peptone, but it was less than half as deep as that obtained with *Bacillus coli* and it did not form as promptly;[a] the organism has lived in agar in the ice box upward of four months; it grows in +15 bouillon at 1° C. and would probably cloud the fluid at 0° C.; 60 to 90 per cent of the rods were killed by freezing (liquid air); it clouds bouillon over chloroform.

In flask cultures in river water containing 2 per cent Witte's peptone and 2 per cent dextrose, there was very copious growth, but most of the bacteria were dead at the end of six weeks, probably because there was a decided acid reaction, in spite of the presence of a small amount of calcium carbonate. The fluid bore floating islands, but no continuous pellicle. Free oxygen is necessary for the production of this acid, i. e., in fermentation tubes containing filtered river water, Witte's peptone, and dextrose or galactose, the clouding, which was prompt and copious, was confined to the bulb and the outer three-fourths of the U, with a sharp line of demarcation where the bacterial growth ceased. Six tubes were inoculated, three of each sugar, and all behaved alike. There was not a trace of clouding in the closed end up to the end of the sixth day, when the experiment was broken off. The organisms from California and Italy behaved alike. The mixed fluid from the open end of the three bulbs containing grape sugar was acid to litmus paper and titrated +41 on Fuller's scale, using phenolphthalein and sodium hydrate; that from the closed end was neutral to litmus and titrated +20 with phenolphthalein and sodium hydrate. The mixed fluid from the three bulbs containing galactose titrated +30; that from the closed end +20. There was no loss of acidity on boiling thirty minutes.

The organism is sensitive to sunlight. In thin sowings in six Petri-dish poured plates in +15 standard agar, exposed on ice, bottom up, to bright sunlight for thirty minutes in April, the covered one-half of each plate promptly developed from 100 to 150 colonies; the exposed one-half of each plate, on the contrary, remained entirely free from colonies (eight days). The temperature did not exceed 18° C.

It appears to be sensitive to acids. The organism is sensitive to copper sulphate (see footnote).

[a] This was repeated in 1908 in peptone water with what appeared to be a negative result, but on standing some days the fluid in the culture tubes became pink, while that in the check tubes did not. These cultures were ten days old.

When inserted by needle punctures into young growing leaves or shoots of the olive, it causes the characteristic galls known in Italy as *rogna* or *tuberculosis* of the olive, and in California as *olive-knot*, *tumor*, or *tubercle*. In my inoculation experiments it has required three to four months for the tubercle to become full grown, and nine to fifteen days for the appearance of elevations on the stem of unmistakable tuberculous character. Earlier than this it has not been possible macroscopically to detect the incipient tubercles with any certainty. Inoculations are most successful when made on the tips of undeveloped shoots in active growth. It is impossible or difficult to induce the formation of tumors on slow-growing or dormant tissues. The organism is most easily recovered in pure culture by making poured plates from the interior of young knots which have not developed fissures, the surface being first sterilized for five minutes in 1:1,000 mercuric chlorid water. The organism does not lose its virulence readily by continued culture in the laboratory, but I have seen some indications of such loss, i. e., slow development of tumors and a larger proportion of failures.

The disease occurs in Italy, France, Spain, Algeria, Tunis, California, etc., injuring the olive and sometimes destroying it. The organism enters the plant, so far as yet known, exclusively through wounds, and sets up an extensive hyperplasia involving various tissues. I failed to obtain the disease by spraying a water suspension of a young virulent culture upon an actively growing olive shoot, kept in moist air under a bell jar. Moïsture in tiny drops persisted on the leaves and stem for a good many hours, but no tubercles resulted (only one experiment, however). The bacteria occur at first between the cells and in small irregular closed pockets, but as the tubercle grows it splits open, foreign organisms appear, and decay sets in. Metastasis occurs, i. e., there are two distinct types of tubercles, primary and secondary, the former due to external infection and beginning in the cortex, the latter due to internal infection and beginning deep in the tissues at the junction of wood and pith.

METASTATIC TUBERCLES.

Metastasis was discovered by Schiff-Giorgini. This was observed and studied by him on natural infections. Recently the writer has also observed it in 10 secondary tumors on shoots and leaves of the 16 inoculated plants referred to below as checks on the oleander inoculations. On one of the leaves the outbreak of the metastatic tubercle, which was watched from its incipiency and before it ruptured the epidermis, appeared on the midrib 4 cm. above the point of inoculation, which was on the stem. On one of the shoots it appeared at a distance of 7 cm. above the primary tubercle. These

secondary tumors are not due to the migration of host cells, but are the result of migrations of the bacteria, which set up local irritations where the secondary tumor arises. The bacteria make their way from the point of inoculation by way of the vascular system. They are easily observed in some portion of the vascular system, usually a very small portion of it, at points anywhere between the primary and the secondary tubercle. In the cases I have studied they were confined to small canals in the inner wood next the pith, these canals being due to the disorganization of a group of vessels. The bacteria were abundant and the walls of the canal were stained yellow and brown. The giving way of the woody structure and the flooding out of the bacteria into softer tissues is apparently what determines the appearance of a secondary tubercle at any particular spot. By splitting the stem lengthwise in the proper place one can trace the canal of infection leading from the primary tumor to the secondary one as a small stained line at the inner border of the wood, easily visible to the naked eye. Sometimes the bacteria are numerous enough in the canal to form a slight ooze on cross section.

THE INOCULATION OF OTHER PLANTS.

This organism apparently is not infectious to *Nerium oleander*. Only six oleander plants were tried, but these very thoroughly, i. e., 18 sets of punctures on as many young actively growing shoots, using agar streaks forty-eight hours old and inoculating very thoroughly, a total of about 150 needle punctures being made. These plants were under observation for five months. No tumors developed. Sixteen olive shoots were held as checks on these oleanders and developed 16 groups of tubercles corresponding to the points of inoculation, and also subsequently metastatic tubercles, as above mentioned. At present, therefore, I am unable to explain the counterstatements of Clayton O. Smith. The oleander tubercle seems to me to be due to *Bacterium tumefaciens* Smith and Townsend.

Apparently the organism is not infectious to *Chrysanthemum frutescens*, i. e., at the same time that the oleanders and olives above referred to were inoculated, actively growing shoots of 12 white daisy plants were inoculated by needle puncture from the same set of cultures. About 120 needle pricks were made and the inoculation was done with great thoroughness, but no tumors developed (five months). *Bacterium tumefaciens* would have produced visible results on the same plants in five to seven days and large tumors in two months.

The above-mentioned sets of inoculations were made in 1907. Earlier in the course of experimentation numerous attempts were made to inoculate the olive disease into ash trees of several species,

privet, and other plants more or less closely related to the olive, but none of the experiments were successful. I still believe it might perhaps be inoculated into *Fraxinus ornus*, my experiments with this species being limited in number and cut short by an accident. Certain slight swellings were visible at the time the plants were destroyed, but the results were not assured. Schiff-Giorgini states that the disease does not occur on the wild olive.

SCHIFF'S ORGANISM A POTATO BACILLUS.

Schiff's organism is *Bacillus vulgatus* (Flügge) Migula or some closely related form, possibly a form near *Bacillus pseudanthracis* Kruse. This will become evident from the following considerations.

SCHIFF'S OWN STATEMENTS.

The principal statements of Schiff respecting the morphology and cultural characters of his organism are condensed as follows from his Italian paper, the starred sentences being observations which the writer has confirmed, using the cultures received from Kornauth:

The organism occurs in the form of long chains or tangled filaments which are usually nonsporiferous, nonmotile, and on staining are seen to be composed of short rods with square ends.* There are also numerous short motile rods with rounded ends, and these in great numbers change quickly into endospore-bearing bodies when grown in culture media.* Transitions occur, the chains becoming shorter and disappearing in old cultures.* Short rods sometimes contain minute irregular granules.* These rods are greenish transparent.* In young cultures on agar, forms occur with and without polar staining. The motile short rods with rounded ends when taken from agar measure 1.6 to 2.2 $\times$ 0.6 to 0.8 μ, or from young cultures 2.5 $\times$ 0.9 μ. On sugar agar they measure 2 to 3 $\times$ 0.8 μ. In broth they are 2 to 3 $\times$ 0.8 μ, or when in chains the segments are 1.8 to 2 $\times$ 0.7 μ. The organism stains by Gram.* We have, therefore, short rods, short chains, long chains, and pseudo filaments, the ends rounded or truncate, and the elements motile or nonmotile depending apparently on whether they are separate or fused into the filaments.*

In suitable media the endospores begin to form the first or second day and finally become more abundant than the nonsporiferous rods.* The sporangia are short elliptical rods in which the endospore is borne centrally and fills nearly the whole body of the sporangium, the latter being swollen slightly around the spore.* Rarely the spore is borne at one end in a swollen portion. The sporangia measure 3 $\times$ 1.2 μ; the endospores measure 1.6 $\times$ 1 μ. The sporangia disappear by solution. The germination of the endospore is central, rarely polar. The flagella are three to four times as long as the rods; they are peritrichiate and eight to ten in number.* They were stained by Gaurnier's method. There is a thin capsule.

On agar the growth is abundant, spreading, lobed, flat.* It is glistening, smooth, becoming rugose, translucent, white to dirty yellow.

On glycerinated potato, growth is abundant, persistent, raised, transparent, white to dirty yellow,* gelatinous.

On glycerin agar, a dry pulverulent surface.

On sugar agar a very rapid spreading growth visible in four to eight hours, slime tenacious. Organism not much inclined to form acids.*

In agar stabs growth best at the top.* Surface growth restricted, lobed; no line of puncture.

Gelatin stab: Liquefaction funnel shaped, abundant at 20° C.*

Nutrient broth: Growth rapid, rim and pellicle present, the latter wrinkled, clouding moderate, fluid turbid, browned, sediment granular pulverulent.* Broth cultures often contain long, tangled chains recalling *Aplanobacter anthracis*.*

Milk is coagulated by a lab ferment and the extrusion of whey begins in two days.* Curd is peptonized in four or five days.

Agar colonies: Growth rapid, surface colonies round to lobed.*

The organism has lived nine months on culture media.* It is a strict aërobe.*

The optimum temperature for growth is 34° to 35° C.* Slow growth at 15° C. Grows well at 37° C.* Maximum temperature for growth 41° C. The spores are not killed by fifteen minutes at 102° C.

There is a slight production of acid on starchy media. Potato starch is destroyed.*

From the results obtained by Schiff we may assume the existence of at least three enzymes: Lab, trypsin, diastase.*

ADDITIONAL OBSERVATIONS BY THE WRITER.

To the foregoing I can add the following from my own studies:

The granules in the short rods stain deeply with carbol-fuchsin, becoming very pronounced. They are one to four or more in number. The length of the filaments from peptonized beef bouillon may be several hundred times their diameter and these long forms are not motile. They stain uniformly and deeply with carbol-fuchsin. Shorter filaments, however, were observed to be motile. The short rods taken from potato cultures were actively motile. I stained the flagella by Pitfield's method. They closely resemble the flagella of *Bacillus vulgatus*.

Intricate criss-cross marks are sometimes present in surface growths on agar. At other times the surface is smooth or finely granular under the lens. Copious wrinkling was readily obtained by adding cane sugar to the agar.

On glycerin agar a dry, white, rough, scaly growth was obtained. Growth on this medium was very abundant in the thermostat at 31° C. (50 times as much as at 20° C.)

In agar stabs the surface growth was thin, white, finely granular under the lens, finally spreading. A distinct stab growth appeared and this was best at the top.

The surface colonies on gelatin develop rapidly and are circular. The margin is fimbriate, as in the case of *Bacillus subtilis*, i. e., fringed with many parallel filaments. Next to this fringed portion in colonies two days old is a finely granular portion consisting of actively motile short rods. The center of the colony contains also tangled chains. These colonies measured 5 to 10 mm. in diameter and the gelatin was fluid except at the margin of the colony.

Gelatin stab: Growth gray white, best at the top; liquefaction rather rapid. It begins in about twenty-four hours at 24° C. and usually ends in five or six days. The tube of liquefaction is at first crateriform, becoming saccate.

A pellicle forms on the surface of milk. In litmus milk there was some formation of alkali but no distinct development of acid. The milk must therefore be coagulated by a lab ferment. In my hands the solution of the precipitated curd was not as rapid as described by Schiff.

In Petri-dish poured plates at 25° and 30° C. the growth of the surface colonies on +15 agar is rapid. They are round, soon becoming irregular, rhizoid; the lobes are often branched repeatedly, as in the case of *Bacillus aroideae*, if the agar is not too dry. The surface is smooth or slightly roughened, gray white, edges entire, becoming variously lobate. Long, narrow crystals are sometimes found in agar cultures.

On potato with 5 per cent glycerin added, growth at first was white or gray white, becoming isabella colored, growth abundant, spreading, rhizoid, dull (shining under hand lens) rugose with dense angleworm-like folds.

Growth on common potato is similar, that is, a much wrinkled, rather dry looking, spreading surface layer develops quickly. This soon thickens and the numerous worm-like folds disappear, so that at the end of six or seven days the surface presents a smooth, thick, shining layer. The substratum meanwhile acquires a slight pinkish tinge or red specks appear here and there. The starch in the potato is destroyed and growth continues for some weeks. The medium remains neutral or with slight variations to either side of the litmus neutral point. The potato cylinders are softened; after six weeks only traces of starch remain.

In Uschinsky's solution the growth was copious but the rim was scanty. No growth was obtained in peptone water with 0.2 per cent

malic acid. No growth was obtained in oxalic acid agar stab cultures. No growth occurs in Cohn's solution.

No gas formation was observed; organism not tested in fermentation tubes.

Peptone water with dextrose becomes dark brown. A nutrient mineral solution (nitrogen-free media) with the addition of sodium asparaginate and cane sugar became dark brown; organism also able to take nitrogen from ammonium lactate, ammonium tartrate, ammonium citrate, and ammonium phosphate. Organism does not grow readily or copiously in distilled water containing only asparagin or in Cohn's solution with asparagin substituted for ammonium tartrate.

Nutrient agar with addition of cane sugar acquires a rèddish brown stain; so does also Hunger's sugar agar using either monopotassium phosphate or dipotassium phosphate. Plain agar did not stain.

Boiled white of egg appears to be acted upon slightly.

Growth in nutrient broth, glycerinated peptone water, Uschinsky's solution, Fermi's solution, etc., is best at the top.

Nitrates are reduced. No indol in old peptone water cultures could be detected with sodium nitrite and sulphuric acid.

The organism lives a long time on culture media. So far as I have observed it is a strict aërobe: It grows feebly in bouillon under olive oil (six days), and in shake-agar cultures buried as soon as solid under another 10 c. c. of agar with olive oil on top, visible growth occurred only in the upper 10 c. c. of agar, and the colonies were largest in the upper strata of this agar (four to nine days).

In streak cultures on litmus agars the organism behaved as follows:

In each of 16 streak cultures on litmus agar there was a copious growth in twenty-four hours, but in forty-eight hours no reddening with plain agar, or the same with addition of lactose, galactose, maltose, mannit, or glycerin. With dextrose and saccharose, however, the litmus was feebly purpled, and this change was visible in twenty-four hours. At the end of seven days the plain litmus agar and that containing lactose and galactose were either slightly bluer or not different from the check tubes. The others were purplish. These litmus agars contained, respectively, dextrose, saccharose, maltose, mannit, and glycerin. None were bright red, only purplish red, and that not very pronounced, although plainly different from the check tubes. The litmus glycerin agar was reddened least, and this change was not visible until after the fourth day. There was no reduction of the litmus in any of the tubes (ten days). After seventeen and thirty days the litmus was reduced in tubes with glycerin. In addition to the carbon compounds to be tested this agar contained only filtered river water and Witte's peptone. We may therefore conclude that the organism is only a slight producer of acids.

When taken from very young bouillon cultures made from similar cultures, i. e., in such a way as to obtain spore-free material, the organism is readily killed by drying. Cloudy bouillon from such tubes when spread on glass cover slips and preserved in ordinary covered Petri dishes for from five to nine days in a closet at room temperatures failed to cloud tubes of bouillon when thrown into them.

That part of Schiff-Giorgini's paper distinguishing two distinct forms of olive tubercle—the primary, due to external infection, and the metastatic or secondary, developing from within—is well worked out and marks a distinct advance in plant pathology.

THE DISEASE IN THE FIELD.

It has been observed over and over again in Italy and elsewhere that rich soil, heavy manuring, and excessive use of water favor the spread of this organism, by producing a great quantity of juicy tissues suitable for infection. This is also true of pear blight. Some varieties of olives seem to be more subject than others. Very sensitive ones should be discarded.

Old tubercles are often eaten by various insects, and it is possible that some insect carrier plays a part in the distribution of this disease. This can be determined only by a prolonged investigation of field conditions supplemented by laboratory studies.

The skillful use of the pruning knife offers some hope. Special knives should be provided for the pruning of diseased trees, or else all the knives should be disinfected after each tree is gone over. In pruning it should be remembered that in some instances the organism may occur in the interior of the stem, some distance below the tubercle. It is wise, therefore, to cut several inches below visible signs. A dab of disinfectant on the cut surfaces, if they are not too numerous, is also to be recommended.

Of germicidal sprays, two may be recommended for trial on a small scale at first, i. e., until it is known definitely whether or not the foliage of the olive will be injured by them. These substances are Bordeaux mixture and the self-boiled lime-sulphur mixture recently devised by Scott for the treatment of peach diseases.[a] If the olive tree will bear either of these germicides, then thorough tests for the control of the disease should be made by giving a half dozen sprayings in the actively growing part of the season.

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[a] See Circular No. 1, Bureau of Plant Industry, 1908.

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B. P. I.—377

THE NECTARIES OF COTTON.[a]

By FREDERICK J. TYLER, *Scientific Assistant, Fiber Plant Investigations.*

INTRODUCTION.

Some natural method of grouping the species of cotton is greatly needed. The cultivated species especially have been confused since the time of Linnæus, and the genus is generally considered very difficult.

It is believed that the interesting diversity which has been noticed between the nectaries of different cottons will form diagnostic characters of considerable value. The nectaries do not change materially through years and even centuries of cultivation, and are not affected by the economic evolution of the plant.

Whatever their origin, they now act as lures for friendly insects and are unusually well developed in most of the species of cotton. Two distinct sets are present in the genus—the floral nectary, which

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[a] With the increasing interest in the development of improved varieties of plants by breeding along definite lines there is a growing demand by economic workers for accurate knowledge regarding distinct species or botanical relationships. For plants that have been long cultivated it is of the utmost importance to find diagnostic characters not subject to variation or affected by cultivation or selection.

In the study of cottons with a view to the description and classification of the cultivated varieties of American Upland cotton a careful study of the species and varieties has been made from growing plants so far as possible. It has been found that the glands, organs of prime importance to the plant itself but of no recognized economic value, and therefore not subject to variation by selection, afford exceptionally good and well-defined characters for identification of groups of species. While some of these nectar-secreting glands have often been referred to heretofore, there has never before been an opportunity for a study of such a wide series, and the rather desultory observations have often been misleading. The results of careful observations made by Mr. Tyler on many hundreds of plants, representing many varieties and species, are here presented with a view to aiding in the determination and classification of the species of Gossypium. The nectary alone, or indeed any one character, is insufficient for classification, but this in connection with others will aid in the identification of species.—B. T. GALLOWAY, *Physiologist and Pathologist, and Chief of Bureau.*

attracts insects useful in effecting cross-pollination, and the extrafloral nectaries, which are feeding places for insects useful to the plant in other ways.[a]

THE FLORAL NECTARY.

The floral nectary consists of a ring of papilliform cells at the base of the inner side of the calyx (see Pl. I, figs. 1 and 2). It is reached from within the corolla by long-tongued bees and butterflies, but is inaccessible to smaller insects, except those so small that they can crawl between the closely fitting calyx and corolla. The five petals overlap, except at their base, where there are five small openings leading down to the nectar. In many species of cotton these gaps are guarded by long, interlacing hairs, which offer no difficulties to the slender tongues of bees and butterflies, but effectually exclude insects too small to be of service as pollinators. The nectary is further protected in some species by a chevaux de frise of straight, stiff hairs, pointing upward toward the mouth of the calyx. These hairs are arranged in the form of a ring, often as broad as the gland itself and located just above it. (See Pl. I, fig. 1.)

The floral nectary has not been described, apparently, by those who have studied the glands of cotton. Trelease,[b] who examined our common cotton (*Gossypium hirsutum* L.), noticed insects putting their tongues through the gaps between the claws of the petals and supposed that the interlacing hairs previously mentioned as closing the gaps in some species were the nectar-secreting organs. Watt sometimes refers to the involucral glands as "floral glands," but overlooks the true floral nectary, although in one instance he figures the ring of hairs above the papilliform zone of the nectary of an African species.[c]

THE EXTRAFLORAL NECTARIES.

The three sets of extrafloral nectaries—the leaf, the outer involucral, and the inner involucral—have often been noticed by botanists and have been employed by them in describing species of cotton, but unfortunately those characteristics have been used which are most variable and of least specific value.

THE LEAF NECTARY.

The leaf nectary (see Pl. I, fig. 6) is located on the under side of the main ribs of the leaf. The glands vary in number from one to

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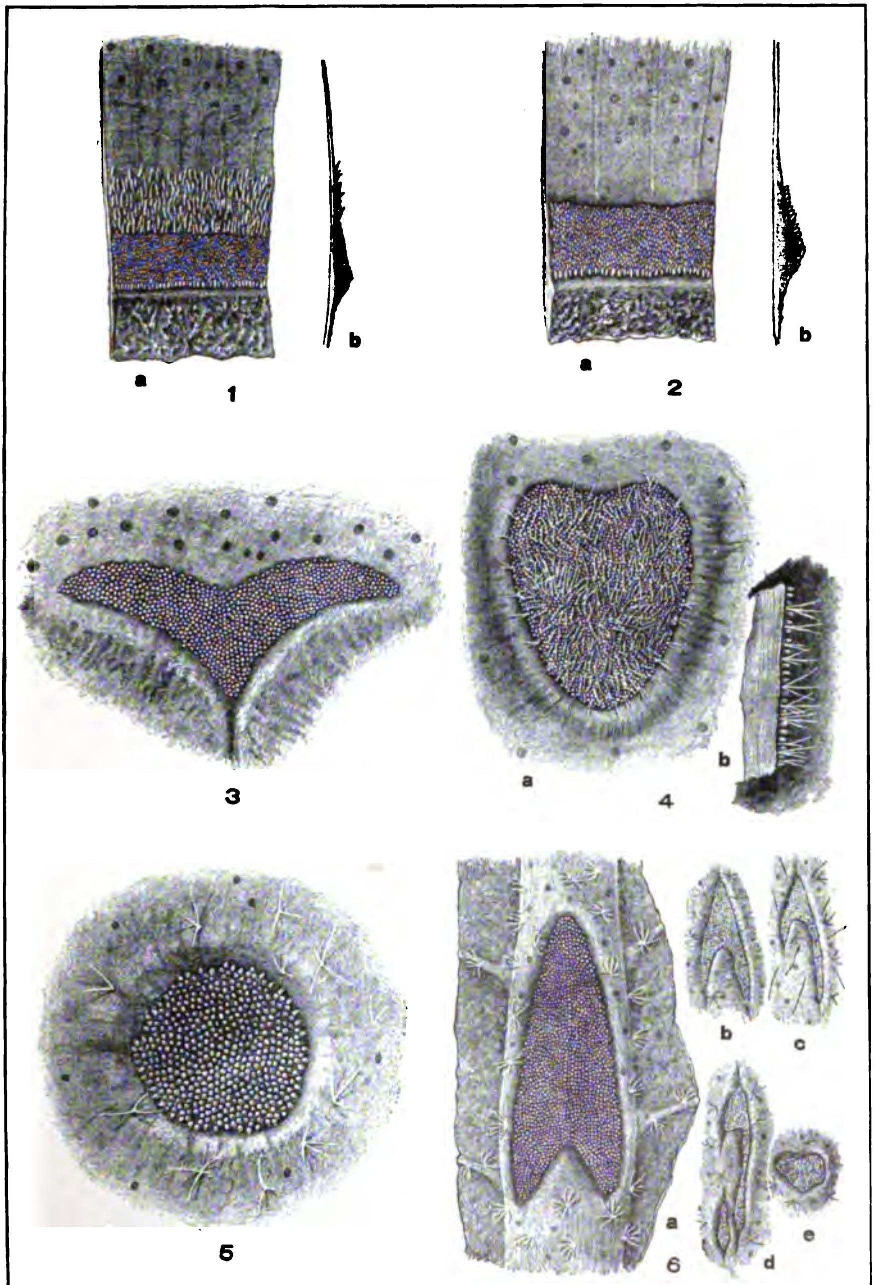
[a] Cook, O. F. Bulletin No. 88, Bureau of Plant Industry, "Weevil-Resisting Adaptations of the Cotton Plant," pp. 30–32. 1906.

[b] Trelease, William, in Comstock's Report upon Cotton Insects, p. 324. 1875.

[c] Watt, Sir George. Wild and Cultivated Cotton Plants of the World, pp. 316–317, pl. 45. 1907.



THE NECTARIES OF COTTON.

five and are often absent in individual leaves, but are perhaps entirely absent in only one species, *Gossypium tomentosum* Nutt. These glands are usually small, rounded, shallow pits, with a floor of round-topped secreting cells. In some species the pit is oval, pear-shaped, or even sagittate, with long tails running down toward the base of the leaf. In the Tropics the leaf glands are soon overrun and blackened by a growth of mold which lives on the secreted nectar.

THE INVOLUCRAL NECTARIES.

The outer involucral glands, three in number, are located at the base of the involucral bracts, on the outside. They are absent entirely in the cultivated cottons of Asia, but are present in all the American species, although not present on every flower. They are usually larger than the leaf glands and form rounded or pear-shaped shallow pits, with a floor of rounded secreting cells. The glands strikingly resemble a shallow, round dish with the bottom covered by a layer of large shot. (See Pl. I, fig. 5.)

The inner involucral nectary (see Pl. I, figs. 3 and 4) also consists of three shallow-pitted glands situated between the calyx and involucre, alternating with the outer glands. This nectary is present in most species of cotton, Asiatic as well as American, though often absent in individual flowers. It is apparently never present in the closely allied genus Ingenhousia, which has been separated from Gossypium on account of the false septa of the ovary. In the Asiatic group of cottons the glands of this nectary are protected by a velvety covering of very short, stellate hairs with erect or ascending branches. (See Pl. I, fig. 4.) This is the more remarkable since the surrounding surface is perfectly glabrous. These glands are naked in all the American species with the exception of a Guatemalan cotton usually considered a form of *Gossypium hirsutum* L., but which is possibly a distinct species. In this case, however, the covering consists of relatively few, very long, branched hairs.

The notes which follow were obtained by the observation of a large number of plants in the field and by examination of the specimens in the herbarium of the United States National Museum and in the Economic Herbarium of the Department of Agriculture. The list of species is incomplete, but all have been included which have been grown by the writer or of which herbarium material could be obtained. In collecting specimens of cotton care should be taken to include several "squares" and buds nearly ready to open, which may be softened and dissected later and the glands studied at leisure.

GROUPS OF SPECIES HAVING SIMILAR NECTARIES.

A. Involucral nectaries both present. American group, also including Bourbon and Scinde cottons.

a. Floral nectary with a band of hairs above.

Gossypium hirsutum L.
Gossypium mexicanum Tod.
Gossypium microcarpum Tod.
Gossypium palmerii Watt.
Gossypium purpurascens Poir.
Gossypium darwinii Watt.
Gossypium stocksii Mast.

b. Floral nectary naked.

Gossypium barbadense L.
Gossypium brasiliense Macf.
Gossypium peruvianum Cav.
Gossypium vitifolium Lam.

B. Outer involucral nectary absent, the inner present, with a covering of stellate hairs. Asiatic group.

Gossypium arboreum L.
Gossypium nanking Meyen.
Gossypium obtusifolium Roxb.
Gossypium herbaceum L.

C. Outer involucral nectary present, the inner absent. Ingenhousia group.

Gossypium davidsonii Kellogg.
Ingenhousia harknessii (Brandegee) Rose.
Ingenhousia triloba Moc. & Sesse.

D. All extrafloral nectaries absent.

Gossypium tomentosum Nutt.

DESCRIPTIONS OF NECTARIES IN EACH SPECIES.

Gossypium hirsutum L. American Upland Cotton.

Leaf glands 1 to 3, usually oval, but often irregular or even sagittate, naked or with a few stellate hairs intruding. (Pl. I, fig. 6, *a*, *d*.)

Outer involucral glands 3, but often one or more wanting, rounded, naked or with a few stellate hairs intruding. (Pl. I, fig. 5.)

Inner involucral glands 3 or less, rounded or oval, naked except in some Guatemalan Upland cottons. These bear a tuft of long, stellate hairs on the gland, the surrounding surface being entirely glabrous.

Floral nectary a zone of papilliform cells with a more or less prominent band of hairs outside. (Pl. I, fig. 1, *a*, *b*.) The Guatemalan and the Dharwar American and other Upland varieties acclimated in India have the band of hairs very strongly developed.

The Moqui cotton and all the commercial varieties of American Upland cottons have the band well developed. This band is apparently always present in the first generation of Upland and Sea Island crosses.

Gossypium mexicanum Tod. Mexican Tree Cotton.

Leaf glands 1 to 3, rounded or ovate slits with swollen sides, or sometimes sagittate with long tails running down toward the base of the leaf, naked.

Outer involucral glands usually 3, narrowly pear-shaped, naked or with stellate hairs intruding from the surrounding surface.

Inner involucral glands usually 3, very broadly V-shaped, naked (Pl. I, fig. 3).

Floral nectary a zone of papilliform cells with a prominent band of hairs outside.

The following cottons belonging to this species were grown and examined: "Cuevas No. 1" and "Cuevas No. 2," from San Luis Soyatlan, Jalisco; "Light's Tree Cotton," from Guadalajara; "Oaxaca," from Oaxaca; "Mexican Tree Cotton," from Mayaguez, Porto Rico.

Gossypium microcarpum Tod., not Watt. Split-Leaved Mexican Tree Cotton.

Leaf glands 1 to 3, usually consisting of narrow slits, naked.

Outer involucral glands 3, narrow, pear-shaped pits, naked.

Inner involucral glands 3, very broadly V-shaped, naked.

Floral nectary a zone of papilliform cells with a prominent band of hairs outside.

The following forms of *Gossypium microcarpum* Tod. have been studied: "Barber's Tree Cotton," from near Matamoras, Tamaulipas, Mexico. "Cuevas Tree Cotton," Nos. 1 and 2, from San Luis Soyatlan, Jalisco, Mexico. The latter were found in seed of *Gossypium mexicanum* Tod. sent from Jalisco by Señor Hilario Cuevas.

Gossypium palmerii Watt. Palmer's Cotton.

Glands very similar to *Gossypium microcarpum* Tod. Seed of this species, which may after all be simply a form of *G. microcarpum* Tod., was obtained from the State of Guerrero, Mexico, and grown under the name "Nolte No. 1." A cotype, N. 184, collected by Dr. Edward Palmer in the vicinity of Acapulco, Mexico, is preserved in the National Herbarium and has also been examined.

Gossypium purpurascens Poir. Bourbon Cotton.

Leaf glands 1 to 3, longitudinal slits or irregular in shape, naked.

Outer involucral glands 3, rounded, naked.

Inner involucral glands 3, rounded-triangular, naked.

Floral nectary a zone of papilliform cells with a very narrow band of hairs above, hardly more than one row.

There is some doubt as to whether the specimen examined, "Spence Tree Cotton," from India, is typical of the above species.

Gossypium darwinii Watt. Galapagos Cotton.

Leaf glands 3, small rounded pits with a few stellate hairs intruding from the surrounding surface.

Outer involucral glands 1 to 3, small rounded pits with a few stellate hairs intruding.

Inner involucral glands 3, low, wide depressions, naked.

Floral nectary a broad zone of papilliform cells with a narrow band of hairs above.

This species, which is related to the *barbadense* group of cottons, is represented in the National Herbarium by a single specimen obtained on Duncan Island, Galapagos, by Alexander Agassiz.

Gossypium stocksii Mast. Scinde Cotton.

Leaf glands obscure or wanting. The leaves are said to be eglandular by Watt,[a] but a large number of the plants must be observed in the field before this point can be decided.

Outer involucral glands 3, consisting of small pear-shaped pits with a few stellate hairs intruding from the surrounding surface.

Inner involucral glands apparently 3, rounded-triangular, the gland as well as entire surrounding surface pubescent with stellate hairs, a character that has been noticed only in one other species, *Gossypium tomentosum* Nutt. Watt[a] states that six small glands are located on the claws of the involucral bracts.

Floral nectary a zone of papilliform cells with a band of hairs above.

A small specimen of *Gossypium stocksii* Mast. is preserved in the National Herbarium. It was collected by Doctor Cooke in Scinde, India.

Gossypium barbadense L. Sea Island Cotton.

Leaf glands 1 to 3, ovate or irregularly sagittate, naked.

Outer involucral glands 1 to 3, often absent, ovate or rounded, naked.

Inner involucral glands usually 3, rounded-triangular, naked.

Floral nectary a zone of papilliform cells without a band of hairs above. (Pl. I, fig. 2, *a*, *b*.)

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[a] Watt, Sir George. Wild and Cultivated Cotton Plants of the World, p. 74. 1907.

"Centerville" and "Seabrook" Sea Island cotton have been grown and examined, and the ordinary Sea-Island cotton of James Island, South Carolina, has been carefully studied.

Gossypium brasiliense Macf. (*G. acuminatum* Roxb.) Kidney Cotton.

Leaf glands 1 to 3, large, usually sagittate, naked or with stellate hairs intruding from the surrounding surface. (Pl. I, fig. 6, *b*, *c*.)

Outer involucral glands usually 3, but often one or more absent, quite large, rounded, naked.

Inner involucral glands usually 3, but sometimes absent entirely, rounded very shallow depressions, naked.

Floral nectary a zone of papilliform cells only.

The following Kidney cottons were grown and examined: "Panuco River," from Tamos, Veracruz, Mexico; "Togoland," from West Africa; "Kafir Kidney," from the Transvaal; "Samar Island," from the Philippines.

Gossypium peruvianum Cav. Peruvian Cotton.

Leaf glands 1 to 3, oval, triangular or sagittate, naked.

Outer involucral glands 3 or less, quite large, rounded pits, naked.

Inner involucral glands 3 or less, oval, naked.

Floral nectary a zone of papilliform cells only.

Seed of this species was obtained from Peru, labeled "Peruvian, Full Rough Catacaos," and was grown in Florida. The annual Egyptian cottons, Ashmuni, Jannovitch, Mit Afifi, etc., have also been grown and studied. Their botanical classification is uncertain, being placed in this species by Doctor Watt, but by many considered forms of *Gossypium barbadense* L. Their floral nectary differs from either in that it has a narrow band of hairs above the papilliform zone.

Gossypium vitifolium Lam. Vine-Leaved Cotton.

So far as can be seen from herbarium specimens the nectaries of this species are similar to those of *Gossypium peruvianum* Cav.

Gossypium arboreum L. Purple-Flowered Tree Cotton.

Leaf glands 1 to 3, usually pear-shaped or irregular, naked.

Outer involucral glands absent.

Inner involucral glands 3, quite large, rounded-triangular or shield-shaped, densely covered by a velvety mass of stellate hairs. (Pl. I, fig. 4, *a*, *b*.)

Floral nectary a zone of papilliform cells only.

The following cottons belonging to this species have been grown and observed: "Narma Bari," from the Saharanpur Botanic Garden,

Saharanpur, India; "Dev Kapas," "Pamidi parutti," etc., from Prof. G. A. Gammie, Poona, Bombay, India; "Siamese Tree Cotton," from Siam.

Gossypium arboreum sanguineum Watt. (*G. sanguineum* Hassk.). Red-Flowered Annual Cotton.

The nectaries are similar to those of *Gossypium arboreum* L.

Seed of "Bagar Siah," a cultivated form of this variety, was obtained from Professor Gammie, of Poona, and grown at Auburn, Ala.

Gossypium arboreum assamicum Watt. (*G. cernuum* Tod.). Assam Cotton.

Nectaries similar to those of *Gossypium arboreum* L.

Seed of several named races of this cotton were obtained from Professor Gammie, of Poona, and also a form known as "Garo," from the Garo Hills, India. Part of these were grown at Auburn, Ala., and at Waco, Tex.

Gossypium arboreum neglectum Watt. (*G. neglectum* Tod.). Bengal Cotton.

Nectaries similar to those of *Gossypium arboreum* L.

Seed of two forms of this species, "Japan Wool" and "Buriah Kapas," from the Louisiana State Experiment Station, Audubon Park, La., and a large number of named varieties from Poona, India, were grown at Auburn, Ala.

Gossypium nanking Meyen. (*G. indicum* Lam.). Chinese Cotton.

Leaf glands 1 to 3, small, oval, or irregular, naked. (Pl. 1, fig. 6, *e*.)

Outer involucral glands absent.

Inner involucral glands 3, large, rounded-triangular or shield-shaped, with a covering of short, stellate hairs.

Floral nectary a zone of papilliform cells, naked or sometimes with a very narrow band of hairs outside.

Seed of this species was obtained from Japan under the names "Kawasaki," "Murasaki," "Akaki," and "Aoki"; from southern Russia under the name "Transcaucasian," and from Korea. A number of named races were obtained from Professor Gammie, of Poona, India.

Gossypium nanking bani Watt. Bani Cotton.

Nectaries similar to *Gossypium nanking* Meyen.

Forms of this variety were obtained from Director D. Prain, Calcutta Botanic Gardens, Sibpur, India, labeled "Common country cotton of India" and "Garo Hills."[a] The latter was often almost

[a] Watt, Sir George. Wild and Cultivated Cotton Plants of India, pp. 118–124. 1907.

glandless except that the floral nectary was always present. It should not be confused with the true Garo or Garo Hills cotton, a form of *Gossypium arboreum assamicum* Watt.

Gossypium obtusifolium Roxb. Ceylon Cotton.

Leaf glands 1 to 3, small, oval or irregular, naked.

Outer involucral glands absent.

Inner involucral glands 3, rounded-triangular in shape, with a covering of short stellate hairs.

Floral nectary a narrow zone of papilliform cells only.

Seed of this species was obtained from the Royal Botanic Garden, Ceylon, and grown in Texas.

Gossypium obtusifolium wightianum Watt. (*G. wightianum* Tod.). Gujarat Cotton.

Nectaries similar to *Gossypium obtusifolium* Roxb.

Seed of several Gujarat cottons belonging to this variety were received from Professor Gammie, of Poona, and grown at Auburn, Ala.

Gossypium herbaceum L. Levant Cotton.

Leaf glands 1 to 3, nearly round or often deltoid in shape, naked or with occasionally a few stellate hairs intruding from the surrounding surface.

Outer involucral glands absent.

Inner involucral glands 3, large, rounded-triangular or shield-shaped, with a covering of short stellate hairs.

Floral nectary a zone of papilliform cells only.

This species, which can hardly be distinguished from many of the forms of *Gossypium obtusifolium*, was grown from seed obtained from Aidin, Smyrna, and from Malta.

Gossypium davidsonii Kellogg. Davidson's Cotton.

Leaf glands 1, small, rounded or pear-shaped, naked, very close to the base of the blade.

Outer involucral glands 3, very small, rounded pits, naked or with stellate hairs intruding.

Inner involucral glands absent.

Floral nectary a zone of papilliform cells with a rather narrow band of hairs outside.

This cotton is intermediate between Gossypium and the closely related genus Ingenhousia, two species of which are included later for the purpose of comparison. As far as can be seen from the herbarium specimens examined, it is similar in seed characters and nectaries to Ingenhousia, but lacks the false septa of the ovary which

characterize that genus. The bracts of the involucre and leaves resemble more closely those of Gossypium. The seed characters of this group are remarkable. The lint or fuzz appears to be entirely absent, but when examined with a lens there is seen to be a very short, minute fuzz, which is plastered close to the surface of the seed.

Specimens of Davidson's cotton from Guaymas, Mexico, from Magdalena Island, and from Cape St. Lucas, Lower California, are preserved in the National Herbarium.

Ingenhousia harknessii (Brandegee) Rose in Herb. (*Gossypium harknessii* (Brandegee).[a]

Leaf glands 1, a very small rounded or pear-shaped pit, very near the base of the leaf.

Outer involucral glands 3, rounded pits reddish brown in color, naked.

Inner involucral glands absent.

Floral nectary a zone of papilliform cells with a narrow band of hairs.

The National Herbarium contains specimens of this plant collected by Dr. Edward Palmer on Carmen Island, Mexico.

Ingenhousia triloba Moc. & Sesse. (*Thurberia thespesioides* Gray.)

Leaf gland 1, a narrow slit with swollen sides, situated very close to the base of the leaf, reddish brown in color, naked.

Outer involucral glands 3, rounded, quite prominent pits.

Inner involucral glands absent.

Floral nectary a zone of papilliform cells with a prominent band of hairs outside.

Numerous specimens of this plant collected in Arizona and Chihuahua are preserved in the National Herbarium.

Gossypium tomentosum Nutt. Hawaiian Cotton.

Leaf glands absent.

Outer involucral glands absent.

Inner involucral glands absent.

Floral nectary a prominent zone of papilliform cells and a narrow band of hairs outside.

Seed and bolls of this variety were obtained from the islands of Oahu and Molokai, Hawaii, and plants were grown in Texas and in the greenhouse at Washington, D. C.

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[a] Brandegee, T. S. Plants of Baja California. Proceedings California Academy of Science, 2d ser., vol. 2, pp. 136–137. 1889.

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 132.

B. T. GALLOWAY, *Chief of Bureau.*

SEEDS AND PLANTS IMPORTED

DURING THE PERIOD FROM JULY, 1906, TO DECEMBER 31, 1907:

INVENTORY No. 13; Nos. 19058 TO 21730.

ISSUED DECEMBER 4, 1908.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 22, 1908.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No, 132 of the series of this Bureau, the accompanying manuscript, entitled, " Seeds and Plants Imported During the Period from July, 1906, to January, 1908: Inventory No. 13; Nos. 19058 to 21730."

This manuscript has been submitted by the Agricultural Explorer in Charge of Foreign Seed and Plant Introduction with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

B. P. I.—379.

SEEDS AND PLANTS IMPORTED DURING THE PERIOD FROM JULY, 1906, TO DECEMBER 31, 1907: INVENTORY NO. 13; NOS. 19058 TO 21730.

INTRODUCTORY STATEMENT.

This inventory, the thirteenth of the series which was begun in 1898, has been prepared under the direct supervision of Mr. Walter Fischer. It brings the total number of introduced plants up to 21,730 and includes 2,672 numbers, covering a period of eighteen months.

A feature of the work of Foreign Seed and Plant Introduction which is growing rapidly and which appears in this inventory is the introduction of small quantities of seeds and plants in response to requests of plant breeders who are at work on particular crops. This feature opens up the whole world as a new field to be explored, for there are hosts of wild forms which are related to our cultivated fruits and cereals and which the plant breeder needs to mix in with his American forms to get new combinations of valuable characters.

For example, the inventory includes seeds of the wild beet of Sicily for the sugar-beet breeder; a wild asparagus from Japan, another from Cape Town, and a third from southern France for the asparagus breeders of the country; wild rhubarbs from China and France; wild plums from Siberia and north China; wild blackberries, raspberries, and strawberries from China; wild currants from Korea; a wild pyrus from Norway; a collection of wild apples and pears from various parts of the world, the gift of the Arnold Arboretum; wild apricots from China; a wild rose from north China; a native wild timothy from Siberia; the *Solanum commersoni*, a wild wet-land potato from Uruguay, and a native wild cherry from Korea. All of these things are already in the hands of plant breeders, who will discover what they have of value in them for the production of new and valuable forms for general cultivation.

This work for the breeders is just beginning. It is longer in bringing in financial results to the country than the introduction of a superior strain of cereal or fruit, but it lies at the bottom of the origination of entirely new things whose possibilities are now quite unknown, and, judging by the experience of the past, it is safe to predict that a single one of these new forms may repay to the farmers or fruit growers of the country hundreds of times what their introduc-

tion has cost. While individual firms, through the increasing intercourse between countries, can be depended on more and more to introduce varieties of staple crops, there is no money to be made from the search for these wild forms for the use of plant breeders, who are generally spending all the money they can spare on their nurseries and trial grounds.

It is therefore a legitimate work for the Government to aid these experimenters, who are at the same time benefactors and who seldom make financial gains from their new originations, because there is no way of retaining control of their sale long enough to make them very profitable.

It may not be out of place to give here some idea of the labor involved in taking care of these new introductions as they come in.

In order to be as sure as possible that no plant gets in which is likely to be a weed or that has on it some dangerous insect pest or other plant disease; that, so far as it is possible to determine from an examination of the seeds or cuttings, the plant comes in under its true name; that the seeds are not dead before they are sent out; that the information which comes with the seeds is recorded on the inventory cards from which this printed inventory is made up, and that the experimenter in the field is written to and the shipment to him recorded in a card catalogue, every new introduction has to pass through the hands of fourteen different clerks or experts.

The time consumed in carrying out these different steps is generally from one to two weeks if there are not discovered on the shipment some diseases which make a quarantine necessary, in which case a much longer time will be required for the necessary fumigation and disinfection.

This large amount of labor is necessary, and it forms one of the reasons why the friends of this work who so kindly offer to send gratis all sorts of things from their regions have to be sent discouraging or rather unappreciative replies. It is such an easy thing to import a small packet of seeds or a few cuttings and such an expensive thing to get it into the hands of a great number of experimenters that unless the attention of the office force is limited to the handling of such things as are on the programme, so to speak, those actually imported will not get the attention they require. With increased funds an increasing number of new introductions will be handled.

Among the more notable collections which appear in this inventory are those of our agricultural explorer Mr. Frank N. Meyer, who has spent the entire time represented by this inventory in northern China and who has with most unusual devotion and bravery gathered together and successfully gotten to this country 680 different things. He has collected personally the seeds and cuttings of valuable trees and shrubs from the neighborhood of Peking; forage crops from

Manchuria, and grasses, legumes, vegetables, cereals, hardy stone fruits, apples, pears, grapes, and ornamentals from northern Korea, eastern Siberia, and Manchuria.

These explorations in China by Mr. Meyer have been the most extensive that have been undertaken by this office and at the same time the most economically conducted. Mr. Meyer has at two different times come very near losing his life, and during a large part of his journeyings he has been subjected to extreme hardships such as few of our previous explorers have had to contend with. His work is deserving of the highest praise.

This inventory also includes the collections of Prof. N. E. Hansen, of the South Dakota Agricultural College, who made, as agricultural explorer of this office, an extensive trip through northern Europe and across Siberia by rail. The results of his collections are recorded in 309 inventory numbers, and these include high-latitude grains and leguminous plants from above the Arctic Circle in Norway and Sweden; interesting forage grasses, clovers, and alcohol potatoes from Russia; vegetables, stone fruits, sorghums, and millets from Turkestan, and new cereals, grasses, alfalfas, and vetches from Siberia. Of these the most remarkable are the wild alfalfas, which form a part of the excellent wild hay of the steppes and which are subjected to most unusual cold and drought, and it is hoped that they will prove of value in the northern area of the Mississippi Valley.

The large importations of matting plants from the Orient which were made by our agricultural explorer Mr. John Tull in 1906 appear in this inventory and represent a difficult piece of introduction work which is likely to be of great value to the Southern States. Several acre plantings from these importations are now growing in the South.

Through a cooperative arrangement with the Arnold Arboretum, Mr. E. H. Wilson, the well-known botanical explorer of China, who is now on the Upper Yangtse River collecting seeds and plants for the arboretum, has secured some wheats, sorghums, raspberries, bamboos, and wild rhubarb of unusual interest, which are listed in this inventory.

Some collections, received through correspondence, of unusual interest are seeds of 28 varieties of dates for the seedling date orchards in the Southwest; 125 varieties of rice from Hawaii; new varieties of mangos, taros, and bananas from various parts of the world, and the Huasco seedless raisin grape from Chile.

DAVID FAIRCHILD,
Agricultural Explorer in Charge.

OFFICE OF FOREIGN SEED AND PLANT INTRODUCTION,
Washington, D. C., May 26, 1908.

INVENTORY.

19058. PERSEA GRATISSIMA. **Avocado.**

From Guatemala. Received through Mr. G. N. Collins, of the Bureau of Plant Industry, in the summer of 1906.

Seeds of a thick-skinned variety.

19060 and 19061.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture. Received July 30, 1906.

19060. LAGENARIA VILLOSA. **19061.** GLIRICIDIA MACULATA.

19062. CARICA PAPAYA. **Papaw.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture. Received August 1, 1906.

"Seed selected from splendid and typical Malay peninsula fruits." (*Lyon.*)

19079 to 19082. PERSEA GRATISSIMA. **Avocado.**

From Guatemala. Received through Mr. G. N. Collins, of the Bureau of Plant Industry, in the summer of 1906.

Plants.

19083 to 19085. DANTHONIA SEMIANNULARIS. **Wallaby grass.**

From Wellington, New Zealand. Presented by Mr. T. W. Kirk, biologist, New Zealand Department of Agriculture. Received August 6, 1906.

"Seed of three local varieties. There is no special distinction between them, they being merely local forms." (*Kirk.*)

19083. (No. 103/0.) **19085.** (No. 103/D.)

19084. (No. 103/11.)

19086. XANTHOSOMA sp. **Yautia.**

From Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, in the summer of 1906.

19087. PACHIRA sp.

From Costa Rica. Received through Prof. H. Pittier, of the Bureau of Plant Industry, in the summer of 1905.

19088. VITIS VINIFERA. **Grape.**

From Coquimbo, Chile. Presented by Mr. Andrew Kerr, United States consular agent, through Mr. David Fairchild, August 10, 1906.

Huasco Seedless. "These cuttings represent the very best grown in the Huasco or Vallenar district. I would advise, however, that the seedless raisin comes rather from the exuberant growth of the plant than from a distinct species. Owing to the excessive quantity of grapes on the bunch, only some become full grown and the stunted ones only are mostly seedless." (*Kerr.*)

19089 and 19090. MANGIFERA INDICA. **Mango.**

From Miami, Fla. Received through the Subtropical Laboratory and Garden, August 10, 1906.

19089. *Mulgoba.* **19090.** *No. 11.*

19093. GNETUM GNEMON.

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture, through Mr. Walter Fischer. Received August 15, 1906.

"A tree of erect habit growing in the East Indian Archipelago, where it is frequently cultivated; fruits edible. The leaves are also eaten when boiled, while cordage is made from the bast of the trunk. Imported not for its economic value, but for the interesting problems in morphology which it presents." (*Fischer.*)

19094. PERSEA GRATISSIMA. **Avocado.**

From Key Largo, Fla. Received through Mr. Edward Gottfried, August 15, 1906.

Seeds of a type of avocado described as follows:

"Shape, ovoid to roundish, obliquity marked. Seed medium, fitting very tightly in cavity and having a closely adherent seed coat which does not remain attached to cavity wall upon removal of seed. Flesh comparatively thick, practically fiberless; relatively large proportion of 'green.' Flavor medium to good. Skin more granular than leathery, thickish, separating readily from pulp. Name suggested for this variety, '*Gottfried.*'" (*Barrett.*)

19095. XANTHOSOMA sp. **Yautia.**

From Santa Barbara, Cal. Presented by Dr. F. Franceschi, of the Southern California Acclimatization Society. Received August 17, 1906.

"Offsets of the Linares, N. L., Mexico, yautia. Probably identical with S. P. I. No. 17149." (*Barrett.*)

19096 and 19097.

From Dehra Dun, India. Received through Mr. Frank Benton, apicultural investigator, U. S. Department of Agriculture, August 16, 1906.

19096. CASSIA sp.

"Seeds of a tree commonly grown for ornament and shade on the plains of India and up to an altitude of 3,500 feet; bears large yellow blossoms." (*Benton.*)

19097. TERMINALIA ARJUNA.

"A shade and ornamental tree growing commonly in the plains—the hottest portions of India. It will also grow at an elevation of 4,000 feet in India, but will not stand severe cold. The wood is useful and the blossoms, which are very sweet scented, are freely visited by bees for honey. The seed is very difficult to germinate. Probably it should be plunged into boiling water." (*Benton.*)

19098 to 19103. ORYZA SATIVA. **Rice.**

From Amani, German East Africa. Presented by Prof. Dr. A. Zimmermann, of the Biologisch Landwirtschaftliches Institute. Received August 20, 1906.

A collection of rice samples, the first five of which are from Neu Lanzenburg, Tenyika District, and the last one from Ujiji, German East Africa. The numbers in parentheses are those assigned by Doctor Zimmerman.

19098. *Sihara.* (No. 138.)

19099. *Hadji jakunjwa.* (No. 139.)

19100. *Mpungara.* (No. 142.)

19101. *Guindimba.* (No. 143.)

19102. (No. 144.)

19103. (No. 145.)

19104. PORTULACARIA AFRA. **Spek-boom.**

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, of the Transvaal Department of Agriculture. Received August 20, 1906. (Professor Davy's No. 87/06.)

"A fleshy, round-leaved, scrubby, soft-wooded tree or bush which is recognized as a very valuable food plant for sheep, cattle, and even horses. Successful efforts have been made to grow it in Namaqualand from cuttings. As these are liable to rot when put in green and nearly severed, they should be spread out for a fortnight to allow the wounds to dry. Where animals are well fed and pampered they sometimes lose taste for this excellent natural food. In the neighborhood of Oudtshoern, on a farm where in the spring of 1895 ostriches were dying in hundreds, clumps of spek-boom were within easy reach, but the birds would not touch it, having been accustomed to feed on lucern. Nevertheless, when birds are brought up to eat it, they thrive well and seem fond of it. The spek-boom is a bush which revives rapidly from the injury done by too close browsing by stock if a season's respite be granted to it. When spek-boom and *Mesembrianthemum floribundum* are present, stock care but little about their daily visits to the water-vlei." (*Wallace. Farming Industries of Cape Colony, p. 88.*) (See also S. P. I. No. 12020.)

19105. ILEX PARAGUAYENSIS.

From Buenos Aires, Argentina. Presented by Hon. Carlos Thays, director, Government Botanical Gardens. Received August 6, 1906.

Native name *Yerba mate.*

19106 to 19110.

From Sydney, New South Wales. Presented by Hon. W. S. Campbell, director, New South Wales Department of Agriculture. Received August 20, 1906.

19106. PENNISETUM SPICATUM. **Pearl millet.**

19107. ANDROPOGON SORGHUM. **Sorghum.**

19108. ANDROPOGON SORGHUM. **Sorghum.**

Planter.

19109. ANDROPOGON SORGHUM.

Early Amber Sugar Cane.

19110. ANDROPOGON SORGHUM. **Kafir corn.**

19111 to 19115.

From Coronel, Chile. Presented by Mr. Teodoro Finger. Received August 20, 1906.

19111. ACACIA CAVENIA.

"Spanish name *Espino chileno.* From central Chile; grows on very dry ground. Its timber is highly esteemed and considered the best for charcoal." (*Finger.*)

"The *Espino* of the present inhabitants of Chile, the *Cavan* of the former population. A small tree with exceedingly hard wood, resisting underground moisture. The plant is well adapted for hedges. The husks contain 32 per cent tannin, particularly valuable as dye material." (*F. v. Mueller.*)

19112. EMBOTHRIUM COCCINEUM. **Firebush.**

"Araucanian name *Notra.* A large, high bush from the south of Chile; of great popularity on account of the large bunches of bright scarlet-red blossoms on each branch. The foliage of long, dark-green leaves is also very ornamental. This bush grows with preference in clayish soil and is found in every garden and park as a favorite plant." (*Finger.*)

"From Chile to the Straits of Magellan. The *Notra* (Araucanian) or *Ciruelillo* (Spanish), a tree of exquisite beauty, but seldom reaching above 30 feet in height. The wood is utilized for furniture." (*F. v. Mueller.*)

19111 to 19115—Continued.

19113. Aristotelia macqui.

"Spanish name *Maqui.* A beautiful evergreen bush or tree which produces a small, reddish black fruit of the size of a pepper. The juice of this fruit is used for coloring wine, and is therefore imported in large quantities to Europe, Argentina, and Peru. It has a sweet-acid taste. The plant prefers alluvial soil along river banks and would pay to be cultivated." (*Finger.*)

"The berries of this plant though small have the pleasant taste of billberries and are largely consumed in Chile. The plant would thrive in mild forest valleys." (*F. v. Mueller.*)

19114. Saxegothaea conspicua.

"Spanish name *Maniu.* This is one of the prettiest Chilean forest trees, growing to a height of 18 meters in dense forests. It is a tree greatly appreciated for its ornamental value in the south of Chile." (*Finger.*)

"The *Mahin* of southern Chile and Patagonia. A medium-sized tree with fine-grained, yellowish timber." (*F. v. Mueller.*)

19115. Guevina avellana. **Chilean nut.**

"Spanish name *Avellana.* This is a tree of great beauty and worth cultivating for its splendid dark green foliage and red, edible fruits. I consider this one of the two prettiest Chilean forest trees. It blossoms and bears through the whole year. It should be planted in shady places and requires continual rains." (*Finger.*)

"The evergreen hazel tree of Chile, extending to the Chonos Archipelago (45° lat. south). One of the most beautiful trees in existence, attaining a height of 30 feet. The snowy white flower spikes are produced simultaneously with the ripening of the coral-red fruit. In the colder southern regions the tree attains considerable dimensions. The wood is tough and elastic and used partly for boat building." (*F. v. Mueller.*)

19116. Gossypium hirsutum. Cotton.

From Deesa, Rajputana, India. Received through Mr. Frank Benton, apicultural investigator, U. S. Department of Agriculture, July 20, 1906.

"(No. 84.) Tree cotton seed. The tree reaches, under favorable conditions, 4 to 5½ feet six months after planting seed; yields the first year 400 to 800 pounds of cotton per acre and four times this after the second year, or 5 to 10 pounds per tree of clean cotton during twenty years or over. Said to have been ranked in Liverpool markets by experts as superfine; white staple, 1 3/16 to 1¼ inches in length; value ⅛ penny per pound above American middling." (*Benton.*)

19117 and 19118. Mangifera indica. Mango.

From West Palm Beach, Fla. Received through Mr. John B. Beach, August 23, 1906.

19117. *Fernandez.* **19118.** *Goa Alfoos.*

19119. Arisaema macrospathum.

From Cuernavaca, Mexico. Presented by Mr. C. G. Pringle, August 27, 1906.

"Corms collected in the 'Pedregal,' near Cuernavaca." (*Pringle.*)

19120. Beta maritima.

From Sicily. Presented by Dr. Carl Sprenger, Hortus Botanicus Vomerensis, Naples-Vomero, through Mr. David Fairchild. Received August 27, 1906.

"*Beta cicla* seeds from Sicily, collected in a wild state and never before cultivated. It is said to be true *Beta cicla*, but I believe it is the true *Beta maritima* really in a wild state, whilst the cicla is more escaped." (*Sprenger.*)

19142 and 19143. XANTHOSOMA spp. **Yautia.**

From Northern Colombia. Presented by Prof. H. Pittier, of the Division of Botany. Received August 31, 1906.

"Rhizomes of two undetermined varieties of yautias which were collected in the Sierra Nevada de Sta. Marta, Colombia, near the Köggaba village of San Andrès, at about 1,200 m. above sea level. The plant is cultivated by the Indians, although not extensively, under the name of *mundi*, or *mi-indi*. The Spanish people call it *malanga*. In the Cauca Valley that same Xanthosoma, or one very like it, is called *rascadera*, a very striking coincidence with the Nahautl word *quequeque*, applied to the same plant in some parts of Central America, the meaning of which is 'that which causes itching,' while *rascadera* signifies 'that which causes one to scratch.'

"The Köggaba Indians cultivate Xanthosoma in the garden-like fields around their houses in isolated plots, mixed in with corn, cane, cotton, coffee, coca, yuca (Manihot). They do not seem to use it to any extent." (*Pittier.*)

19145. CASTALIA MEXICANA.

From City of Mexico, Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, September 4, 1906.

"(No. 06/1044.) Roots of a beautiful plant with rose-colored sepals and pale-yellow flowers, opening in the afternoon." (*Rose.*)

19146 and 19147. PERSEA GRATISSIMA. **Avocado.**

From Querétaro, Mexico. Presented by Sr. M. M. Urquiza. Received September 4, 1906.

Cuttings of two unnamed varieties.

19148 to 19150.

From Georgetown, British Guiana. Presented by Mr. Donald Mitchell, U. S. vice and deputy consul, through Mr. O. W. Barrett. Received September 4, 1906.

19148. CALADIUM sp.

Native name *Bush hog beena.*

19149 and 19150. XANTHOSOMA spp. **Yautia.**

19149. A variety having yellow tubers.

19150. A variety having white tubers.

19151. PERSEA GRATISSIMA. **Avocado.**

From Campeche, Mexico. Presented by Mr. F. Foex. Received September 4, 1906.

"Though coming from a hot country, it was fine and delicate, very big, and of good shape." (*Foex.*)

19152 to 19166.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College. Received June 6, 1906.

19152. MELINIS MINUTIFLORA. **Molasses grass.**

"(No. 1.) Purchased from a grower under the name of *Catengueiro roxa* (red), but appears to be nearly all *Catengueiro blanca* (white), which is not as valuable as the former. Our principal winter grazing grass." (*Hart.*)

19153. PASPALUM DENSIFLORUM.

(Hart's No. 2.)

19152 to 19166—Continued.

19154. PANICUM MAXIMUM. **Guinea grass.**

"(No. 3.) Local name *Capim Guinæ da Bahia.*" (*Hart.*)

19155. CHAETOCHLOA sp.

"(No. 4.) Probably of little or no value." (*Hart.*)

19156. LEPTOCHLOA GRACILIS.

"(No. 5.) Eaten by animals with relish." (*Hart.*)

19157. PANICUM MAXIMUM. **Guinea grass.**

"(No. 6.) Local name *Grama colonia.* Much esteemed for hay and pasture. Grows 2 meters high on good land." (*Hart.*)

19158. TRICHOLAENA ROSEA.

"(No. 7.) Local name *Favorita.* A splendid variety for hay." (*Hart.*)

19159. CASSIA sp.

"(No. 26.) A legume found growing on uncultivated land; shrub about 0.75 meter high; doubtless owing to the renovating effect of this and related species the high fertility of the soil here is partly due." (*Hart.*)

19160. CASSIA sp.

"(No. 27.) Shrub about 0.6 meter high. Similar to preceding number." (*Hart.*)

19161. CASSIA sp.

"(No. 28.) A leguminous annual shrub, about 60 centimeters high, bearing an enormous crop of seed. Found on borders of cultivated fields and in pastures. Not eaten by stock." (*Hart.*)

19162. ANDROPOGON HALEPENSIS. **Johnson grass.**

"(No. 29.) An indigenous grass similar to Amber sorghum cane when growing." (*Hart.*)

19163.

"(No. 30.) A leguminous vine growing wild in abandoned fields." (*Hart.*)

19164. CHAETOCHLOA sp.

"(No. 31.) A large, coarse grass growing in open places in forests; eaten by horses. Its robust habit and strikingly veined blades would suggest its trial as an ornamental grass." (*Hart.*)

19165. PANICUM sp.

"(No. 33.) A grass found growing sparingly in the shade; not cultivated." (*Hart.*)

19166. PANICUM sp.

"(No. 34.) A grass found on the margin of the forest on somewhat moist soil; probably of no agricultural value." (*Hart.*)

19167. PERSEA GRATISSIMA. **Avocado.**

From Querétaro, Mexico. Presented by Sr. M. M. Urquiza. Received September 7, 1906.

Seed.

19168. ORYZA PUNCTATA. **Rice.**

From Ujiji, German East Africa. Presented by Dr. G. Schweinfurth, Berlin, Germany, through Mr. David Fairchild. Received August 27, 1906.

Wild rice to be used in breeding experiments for the production of more disease-resistant varieties.

19169 to 19172.

From Dominica, British West Indies. Presented by Mr. A. Hyatt Verrill. Received September 8, 1906.

19169. TRIMEZIA LURIDA.

19170. ZEPHYRANTHES TUBISPATHA.

19171. XANTHOSOMA sp. **Yautia.**

A yellow variety.

19172. XANTHOSOMA sp. **Yautia.**

A white variety.

19173. CASTALIA GRACILIS.

From Mexico City, Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, September 6, 1906.

"(No. 06/1,076.) Nearly spherical roots from ½ to 1 inch in diameter and of a black color." (*Rose.*)

19174. PARTHENIUM ARGENTATUM. Guayule.

From Saltillo, Mexico. Presented by Mr. Victor L. Duhaime, American consul, through Mr. David Fairchild. Received August 28, 1906.

Seed for use in germination experiments with a view to finding out whether this plant will adapt itself to irrigated or alluvial lands.

19175. NEPHELIUM LONGANA. Longan.

From Oneco, Fla. Presented by Mr. E. N. Reasoner. Received September 1, 1906.

Seeds for experiments in raising stock upon which to graft the litchi.

19178 to 19182.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College. Received September 1, 1906.

19178. HYMENAEA STIGNOCARPA.

This tree probably resembles *H. courbaril* of tropical South America, famous for its valuable, hard, close-grained, heavy timber and its fragrant amber-like resin, known as West Indian copal. In this species the beans are also lodged in a mealy pulp of honey-like taste, which can be used for food.

19179. LUEHEA SPECIOSA.

One of a genus of Tiliaceous trees and shrubs with handsome white or rosy flowers borne in terminal panicles or in the axils of the leaves.

19180. BAUHINIA FORFICATA.

19181. MUCUNA NIVEA.

"Similar to the Florida velvet bean but later and more robust; produces an enormous growth of vines. The beans grow in long clusters, one to five in a pod; the clusters sometimes reach a length of 1 meter and contain as high as seventy pods. I have been told that this vine lives for three or four years." (*Hart.*)

19182. NICOTIANA TABACUM. **Tobacco.**

Havana.

19183 to 19192.

From Manchuria. Received through Mr. F. N. Meyer, agricultural explorer, August 28, 1906.

A collection of seeds, as follows:

19183. GLYCINE HISPIDA. **Soy bean.**

From Newchwang. "(No. 255a.) A small variety of the black soy bean. Used to make bean oil from, the remaining expressed material, known as bean cake, being exported to Japan and southern China as a very valuable fertilizer." (*Meyer.*)

19184. GLYCINE HISPIDA. **Soy bean.**

From Newchwang. "(No. 256a.) A large variety of the black soy bean. This is a very rare variety and is used for food: also for making a superior oil." (*Meyer.*)

19185. PHASEOLUS ANGULARIS. **Adzuki bean.**

From Newchwang. "(No. 257a.) A small, ovoid, yellowish bean; sold in Newchwang as a food for the Chinese. Seems to be unknown in other parts of China." (*Meyer.*)

19186. GLYCINE HISPIDA. **Soy bean.**

From Newchwang. "(No. 258a.) A medium-sized, greenish soy bean. This variety is the one most commonly used to extract bean oil from, the remaining yellow material, in the form of large, flat cheeses, being exported to different parts of Japan and especially to southern China as a very valuable fertilizer." (*Meyer.*)

19187. ANDROPOGON SORGHUM. **Sorghum.**

From Newchwang. "(No. 259a.) Chinese name *Kauliang.* A brown-colored variety of sorghum said to be grown on the rather alkaline lands around Newchwang." (*Meyer.*)

19188. ORYZA SATIVA. **Rice.**

From Newchwang. "(No. 260a.) A reddish variety of dry-land rice obtained from the magistrate of Hai-tcheng, Mr. Kuan Fing Ho, through the efforts of the American consul-general, Mr. M. T. Simmons, at Newchwang. As the city of Hai-tcheng is situated close to latitude 41°, this rice may be expected to succeed in the New England States, but it certainly will grow in the Middle Western States." (*Meyer.*)

19189. PHASEOLUS VULGARIS. **Bean.**

From Shan-hai-kwan, China. "(No. 261a.) A rosy colored variety of a bush haricot bean which is eaten green as a vegetable." (*Meyer.*)

19190. PHASEOLUS VULGARIS. **Bean.**

From Shan-hai-kwan. "(No. 262a.) A light brown colored variety of a bush haricot bean; used as a vegetable in the green state." (*Meyer.*)

19191. PHASEOLUS VULGARIS. **Bean.**

From Shan-hai-kwan. "(No. 263a.) A red-brown colored variety of a climbing haricot bean; used as a vegetable when green." (*Meyer.*)

19192. PHASEOLUS VULGARIS. **Bean.**

From Kau pan-tze. "(No. 264a.) A dark, red-brown colored variety of a climbing haricot bean; used as a vegetable when green." (*Meyer.*)

19193 to 19195. ORYZA PUNCTATA.

From West Africa. Received from Dr. Christian von Liszewski, Marseille, France, through Mr. David Fairchild, September 1, 1906.

19193.

"*Konkoi.* Marsh rice. Plant rough; vigorous; stem stout; little subject to lodging; heavy bearer. Period of growth from five to six months;

19193 to 19195—Continued.

relatively early; very robust; little subject to attacks of fungous diseases; very much valued by the natives for food. This variety requires very little cultivation. It must be sown a month and a half or two months before the end of the rainy season. The submerged fields are very prolific for this kind of rice." (*Liszewski.*)

19194.

"*Talifori.* Mountain rice. Plants strong, of medium height; early. Period of growth from three to four months, which allows the natives to harvest two crops of this rice in one season. Sown in May or June, a month and a half before the end of the rainy season; last sowing in August and September. It is a good yielder. The rice is valued by the natives for food and is considered the most nutritious of the mountain rices. According to tradition this rice is the most ancient of all the rices of Africa and is very characteristic of the region west of French West Africa." (*Liszewski.*)

19195.

"*Kontondi.* Valley rice. Plants tall, vigorous, slightly rough; straw slightly hollowed; requires a dry seed bed; absorbs much of the nitrogenous matter of the soil; is a prolific bearer and must not be sown two years in succession in the same place. As a food this variety of rice is not valued by the natives, so that it would be difficult to procure, since it grows very far from the routes of travel." (*Liszewski.*)

19196. Persea gratissima. **Avocado.**

From Parras de la Fuente, Coahuila, Mexico. Presented by Dr. A. Walther, through Mr. O. W. Barrett, September 17, 1906.

Cuttings of a hardy avocado.

19197 to 19199. Nicotiana tabacum. **Tobacco.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture. Received September 17, 1906.

19197.

"*Daluzon.* A variety with large, wide leaves." (*Lyon.*)

19198.

"*Espada.* A variety with narrow, thick leaves." (*Lyon.*)

19199.

"*Marugui.* A variety with large, broad, thin leaves." (*Lyon.*)

19203. Ipomoea horsfalliae briggsae.

Plants propagated in the Department greenhouse. Numbered, for convenience in recording distribution, September 19, 1906.

19204. Cryptostegia grandiflora.

From Bahama Islands, British West Indies. Received through Mr. G. N. Collins, of the Bureau of Plant Industry. Numbered, for convenience in recording distribution, September 19, 1906.

Seedlings grown from seeds obtained from fruits which were sent to Mr. Collins for determination.

19205. Centrolobium robustum.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College. Received September 20, 1906.

19206. PERSEA GRATISSIMA. **Avocado.**

From Parras de la Fuente, Coahuila, Mexico. Presented by Dr. A. Walther, through Mr. O. W. Barrett, September 20, 1906.

"Seeds of a green-fruited variety; probably identical with budwood sent under No. 19196." (*Barrett.*)

19213 to 19216.

From Manila, P. I. Received through Mr. W. S. Lyon, of the Bureau of Agriculture, September 24, 1906.

19213. ANDROPOGON SORGHUM. **Sorghum.**

Variety *negrosense.*

19214. ANDROPOGON SORGHUM. **Sorghum.**

Variety *negrosense erythrinium.*

19215. AFZELIA RHOMBOIDEA. **"Tindalo."**

"One of our choicest hardwood timbers." (*Lyon.*)

19216. DIOSPYROS DISCOLOR.

"This is a beautiful tree and has the most attractive and luscious looking fruit I know of, comparable only to a large, velvety, Indian, blood peach. As for taste—well, there is a time-worn French proverb that most people apply—'I like it, but then I am not a competent judge.'" (*Lyon.*)

19217 to 19225.

From Paramaribo, Dutch Guiana. Presented by Dr. J. J. Van Hall, Director of Agriculture, through Mr. O. W. Barrett, September 25, 1906.

19217 to 19219. XANTHOSOMA spp. **Yautia.**

19217. *Surinam.*

19218. (Not labeled.)

19219. (Not labeled.)

19220. COLOCASIA sp. **Taro.**

Wittie.

19221 to 19225. XANTHOSOMA spp. **Yautia.**

19221. *Koso.*

12222. *Abo.*

19223. *Redie.*

19224. *Sinesie.*

19225. *Finga.*

19226. DIOSPYROS TEXANA.

From Falfurrias, Tex. Collected by Mr. David Fairchild, August 8, 1906.

Seeds for hybridizing experiments. "Tree reaches a height of 30 feet; fruit globose, black, and luscious." (*Gray.*)

19228. ARTOCARPUS INCÍSA. **Breadfruit.**

From Ancon, Canal Zone, Panama. Received through Mr. H. F. Schultz, September 27, 1906.

19240. MEDICAGO SATIVA. **Alfalfa.**

From Callao, Peru. Presented by Mr. Joseph C. Cree, U. S. consul. Numbered October 2, 1906.

19241. TACCA PINNATIFIDA. **Fiji arrowroot.**

From Honolulu, Hawaii. Received through Mr. Jared G. Smith, Agricultural Experiment Station, October 4, 1906.

Hawaiian name, *Pia.*

19242. Paspalum dilatatum. **Large water-grass.**

From Central Bucca, New South Wales. Received through Mr. W. Seccombe, September 10, 1906.

19245 to 19257.

From Waroona, West Australia. Presented by Mr. Geo. F. Berthoud, State Farm, Hamel. Received September 6, 1906.

19245. Danthonia sp. **Wallaby grass.**

19246. Anthistiria ciliata. **Kangaroo grass.**

19247. Panicum decompositum.

19248. Danthonia sp. **Wallaby grass.**

A tall, slender variety.

19249. Panicum flavidum.

19250. Danthonia sp. **Wallaby grass.**

A dwarf variety.

19251. Danthonia sp.

A variety from Collie River.

19252. Andropogon bombycinus.

19253. Danthonia sp. **Wallaby grass.**

19254. Andropogon erinthoides. **Satin top grass.**

19255. Panicum prolutum.

19256. Danthonia sp. **Wallaby grass.**

19257. Eragrostis pilosa.

19258 and 19259.

From Mexico City, Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, October 8, 1906.

19258. Castalia pringlei. **Water lily.**

"Rhizomes of a white-flowering variety." (*Rose.*)

19259. Beschorneria yuccoides.

"(No. 06/1,218.) A very rare ornamental plant; also contains a good fiber. A very near relative of *Furcræa*, which furnishes the best Mexican fiber. Grows at an altitude of 10,000 feet or more, along with the firs, spruces, pines, and oaks." (*Rose.*)

19260. Nymphaea elegans. **Water lily.**

From Harligen, Tex. Presented by Mr. Chester B. Davis, through Mr. David Fairchild, October 24, 1906.

"Roots and seed vessels collected from plants growing in a pond 1½ miles east from Lonsboro, north of the railroad." (*Davis.*)

19261 to 19263. Juglans nigra × regia. **Walnut.**

From Tettington, Va. Secured by Mr. Walter Fischer, scientific assistant, October 9, 1906.

"This tree is growing on what was known as the Rowe farm, the property of Mr. Benjamin H. Harrison, opposite lower Brandon, near Tettington, on the James River. It is a magnificent specimen of its kind; a broad, spreading tree about 100 feet in height with a circumference of 33 feet 3 feet from the ground and of 25 feet 6 feet from the ground. At a height of 12 feet it divides into four large branches, three of which are larger than any forest trees in the vicinity. A short distance from this giant tree is another of the same kind.

19261 to 19263—Continued.

It is of the same height and general habit and about 2½ feet in diameter. This is said to have grown from a seed of the larger tree planted at the time of the civil war. Neither of these trees are very prolific bearers; the larger one is said to have borne about a peck of nuts while in its prime, but at the present time the crop does not amount to more than 2 dozen nuts; the other tree bore about half this quantity.

"The trees seem to have characteristics between those of our native black walnut, butternut, and the Persian walnut. The twigs, buds, and leaves resemble the last named; the outer rind of the fruit resembles that of our native black walnut and the nut itself inclines slightly toward that of the butternut. Both the outer and the inner husks of the nut are very thick shelled, and the kernel is very small in proportion. It has poor germinating powers, which probably indicates a hybrid weakness.

"No history of the large tree is available. It was described by Prof. J. T. Rothrock in Forest Leaves, vol. 2, p. 133, who suggests that it is a hybrid between *J. nigra* and *J. regia*. In spite of the strong resemblance of this tree to those parents, the fruit does not at all agree with hybrids which are known to have been bred from those two species (S. P. I. Nos. 21612 and 21710). This, however, may be a variation due to its hybrid origin. The abnormal length of the fruit of the James River hybrid suggests slightly the butternut (*J. cinerea*), but the younger of the two trees shows quite a tendency in its twigs to revert to *J. nigra*, although the nuts can not be distinguished from those of its parent.

"The size of these trees proves them to be of extraordinarily rapid growth, for allowing for them the natural rate of growth of our native walnuts it would be impossible to account for the origin of the larger tree as a hybrid between American and European species, as its size would indicate that it was planted perhaps before the settlement at Jamestown. It is in all probability, however, not more than 150 or 200 years old. Scions have been secured for grafting upon the native walnut as a possible rapid-growing timber tree to furnish the highly prized walnut lumber. Experiments by Mr. Luther Burbank in California in grafting hybrids upon the slower-growing native trees have shown that the scions stimulate the stock to even faster growth than themselves. Their rapid growth, hence, would present no obstacle to their propagation by grafting." (*Fischer.*)

19261. Nuts of both trees, mixed by accident.

19262. Scions of the parent tree.

19263. Scions of the second generation.

19264 to 19268.

From London, England. Received through James Veitch & Sons, October 13, 1906.

19264 to 19267. CRAMBE MARITIMA. **Sea kale.**

19264 and 19265. *Beddard's Improved.*

19266 and 19267. *Lily White.*

19268. CYNARA SCOLYMUS. **Artichoke.**

Globe.

19269. BAMBUSA TULDA. Bamboo.

From Sibpur, Calcutta, India. Presented by Mr. A. Gage, curator, Royal Botanic Garden. Received October 12, 1906.

(See also S. P. I. No. 21002.)

19270. COLOCASIA sp. Dasheen.

From Paramaribo, Surinam. Presented by Mr. H. Polak, at the request of Dr. J. J. Van Hall, Director of Agriculture for the Dutch West Indies. Received October 13, 1906.

"Tubers of a new variety of tayer, called *Eksi-taja*, which means egg-tayer." (*Polak.*)

19271. XANTHOSOMA sp. **Yautia.**

From Kingsville, Tex. Presented by Mr. John D. Harvey, October 13, 1906.

19272. CYNARA SCOLYMUS. **Artichoke.**

From Paris, France. Received through Vilmorin-Andrieux & Co., October 16, 1906.

Flat Brittany.

19273. DOLICHANDRONE RHEEDII.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, October 12, 1906.

19274 and 19275. ASPARAGUS spp.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, of the Transvaal Department of Agriculture. Received October 15, 1906. Imported for work in asparagus-breeding experiments.

19274. (Davy's No. 2968/1151/06.)

19275. (Davy's No. 1049/06.)

"Collected in the Ermelo District, on the high veld between 4,000 and 5,000 feet altitude, subject to a summer rainfall of 26 inches, with considerable heat, but a completely dry, cold winter of about five months' duration." (*Davy.*)

19276. PINUS LONGIFOLIA. **Pine.**

From Jamaica Plain, Mass. Presented by Prof. C. S. Sargent, of the Arnold Arboretum. Received September 1, 1906.

"This is an Indian species and not the same as *P. roxburghi*, which is the same as *P. excelsa.*" (*Sargent.*)

19277. APIUM GRAVEOLENS (?).

From Port Stanley, Falkland Islands. Secured by Mr. John E. Rowan, U. S. consul. Received October 18, 1906.

A wild celery introduced for breeding purposes with the cultivated forms.

19279. SCIRPUS TUBEROSUS.

From China. Received through Mr. John Tull, special agent, October 16, 1907.

Japanese nut *Kuro-kuwai.* "(No. 1.) Roots of a bulbous plant of Cyperaceæ, growing wild in marshy places; also cultivated in paddy land for tubers. In winter they are dug and eaten either raw or boiled, resembling a chestnut in taste. In China starch is made from them and called *Batei-fun.* This is the Chinese variety which is largely imported into Japan to eat raw. These roots were purchased on the market in Yokohama, Japan." (*Tull.*)

19282. LATHYRUS TINGITANUS. **Tangier scarlet pea.**

From Algiers, Algeria. Received through Dr. L. Trabut, October 19, 1906.

19284 to 19287.

From Tehuacan, Puebla, Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, October 22, 1906.

19284. BEAUCARNEA OEDIPUS, Rose.

"(No. 11220.) One of my new species and is one of the most remarkable desert plants I have ever seen." (*Rose.*)

19284 to 19287—Continued.

19285. Pistacia mexicana.

(Rose's No. 11234.) "A small Mexican tree with pinnate leaves and dioecious flowers with no petals and five stamens; the small, somewhat compressed nut is edible. This species grows in the valley of the Rio Grande and Lower Pecos. It is of no economic value in its present state, but may prove to be very useful as a drought-resistant stock upon which to graft the finer varieties of pistache." (*Charles J. Brand.*)

19286. Sphaeralcea umbellata.

"(No. 11244.) Has a rather large pinkish flower and forms a bush 10 to 12 feet high. It is often planted as an ornamental shrub in gardens at an altitude of from 4,000 to 5,000 feet in south Mexico." (*Rose.*)

19287. Prunus capollin. **Wild cherry.**

"(No. 11525.) Purchased in a Mexican market, where the dried fruits are sold. This Prunus often forms a very large tree." (*Rose.*)

19292. Citrus decumana. Pomelo.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, October 23, 1906.

"Native name *Lukban;* a pomelo of good quality and large size." (*Lyon.*)

19293. Xanthosoma sagittifolium. Yautia.

From McKinley, Isle of Pines, Cuba. Presented by Mr. George F. Young, through Mr. O. W. Barrett. Received October 27, 1907.

White Malanga.

19294. Mangifera indica. Mango.

From Oneco, Fla. Received through Mr. E. N. Reasoner, October 29, 1906.

Enuria.

19297. Persea gratissima. Avocado.

From Cocoanut Grove, Fla. Propagated at the Subtropical Laboratory and Garden, Miami, Fla., and numbered for convenience in recording distribution, November 3, 1906.

Wester. "(Lab. No. 551.) The seed was planted thirty-five years ago (1871) by John Thomas Peacock, but he can not recollect from where it came—probably, however, from Key West. The tree is now (November, 1906) 25 feet tall, with a spread of 28 or 30 feet and a diameter of 15 inches 1 foot above the ground, and is vigorous and thrifty. According to Mr. Peacock, the tree has been a heavy bearer every year since it began to bear." (*Wester.*)

19300 to 19366. Musa spp.

From Mayaguez, P. R. Received from Mr. H. C. Henricksen, of the Agricultural Experiment Station, through Mr. O. W. Barrett, October 17, 1906.

19300 to 19313. Musa sapientum. **Banana.**

19300. *Canarias* (from No. 10965).

19301. *Canarias.*

19302. *Ingles.*

19303. *Chamaluco.*

19304. *Cenizo.*

19305. *Prieto.*

19306. *Chinese* (from No. 10965).

19300 to 19366—Continued.

19307. *Canarias* (from No. 9575), "*Datile.*"
19308. (Not labeled.)
19309. *Chamaluco Pato.*
19310. *Guaran.*
19311. *Hart's Choice.*
19312. *Golden.*
19313. *Johnson* (Cuba).

19314 to 19318. MUSA CAVENDISHII. **Banana.**

19314. *Enano* (Porto Rico).
19315. *Enano Doble* (?).
19316. *Enano* (Cuba).
19317. *China* (Jamaica).
19318. *Cavendishii.*

19319 to 19332. MUSA SAPIENTUM. **Banana.**

19319. *Dominico.*
19320. *Rosa.*
19321. *Dátyl.*
19322. *Niño.*
19323. *Red Jamaica.*
19324. *Morado Colorado* (Cuba).
19325. *Morado.*
19326. *Morado blanco.*
19327. *Rubra.*
19328. *Apple* (Hawaii).
19329. Apple (2d) (Hawaii).
19330. *Manzano* (Cuba).
19331. *Apple* (Jamaica).
19332. *Manzano.*

19333 to 19342. MUSA SAPIENTUM. **Plantain.**

19333. *Congo Colorado.*
19334. *Congo Blanco.*
19335. *Congo Morado.*
19336. *Congo Manila.*
19337. *Maricongo.*
19338. *Plátano Morado.*
19339. *Plátano "tres cientos."*
19340. *Chue Chumpa.*
19341. *Plátano Negro.*
19342. *Plátano Hartón.*

19343 to 19365. MUSA spp. **Banana.**

19343. *Kapua* (Hawaii).
19344. *Brazilian* (Hawaii).
19345. *Hau Moa* (Hawaii).
19346. *Lele* (Hawaii).
19347. *Maole* (Hawaii).
19348. *Hai* (Hawaii).
19349. *Kudjo Hudang.*
19350. *Martaban* (Calcutta).
19351. *Palembang.*
19352. *Rajah.*
19353. *Ambon.*
19354. *Kelat.*
19355. *Guindy.*
19356. *Cincrea.*
19357. *Discolor* (Kew).
19358. *Maas.*
19359. *Almeido.*
19360. *Dacca.*
19361. *Soosoo.*
19362. *Martabanica.*
19363. *Lady-Finger* (Pashongar).
19364. *Lady-Finger* (Jamaica).
19365. *Tirabuzón.*

19366. MUSA TEXTILIS. **Manila hemp.**

Abacá (Philippine Islands).

19367. Aegle marmelos. **Bengal quince.**

From Honolulu, Hawaii. Received through Mr. J. G. Smith, of the Agricultural Experiment Station, November 5, 1906.

Sometimes called *Elephant Apple*, *Maredoo*, or *Bhel Fruit.*

19368. Hicoria laciniosa. **Big shagbark hickory.**

From Columbia, Mo. Presented by Mr. C. C. Bateman, October 17. 1906.

19369. Nymphaea sp. **Pond lily.**

From Harligen, Tex. Presented by Mr. Chester B. Davis, November 6, 1906.

"These lilies are said to bear most beautiful flowers and very large ones. The leaves are larger than those of No. 19260. The two lots were not from the same locality." (*Davis.*)

19370. Sechium edule. **Chayote.**

From Saltillo, Mexico. Received through Mr. J. R. Silliman, October 30, 1906.

"A spiny variety of the Mexican chayote, secured for distribution among vegetable growers in the South as a possible new paying vegetable." (*Fairchild.*)

19371. Persea indica.

From Canary Islands. Presented by Dr. A. Robertson-Proschowsky, Nice, France. Received November 5, 1906.

(See notes to S. P. I. Nos. 14498 and 16133.)

19373. Panicum curvatum. **Ukoka grass.**

From Zanzibar, British East Africa. Presented by Mr. R. N. Lyne, director, Department of Agriculture. Received November 5, 1906.

"Native name *Ukoka.* The grass is a creeper; grows wild and luxuriantly on the plantations, all classes of stock being very fond of it. It is the only forage grass on this island gathered and supplied to stock. It enjoys a light loamy soil and requires abundant rain. I believe that in humid localities you would find it most valuable forage." (*Lyne.*)

19376. Musa sapientum. **Banana.**

From Oneco, Fla. Received through Mr. E. N. Reasoner November 12, 1906.

Large Figue.

19377 to 19380. Persea gratissima. **Avocado.**

From Hawaii. Seedling avocados grown from seeds taken from fruits shipped to the Office of Pomological Investigations of the Bureau of Plant Industry in 1904; turned over to the Office of Seed and Plant Introduction and Distribution on November 7, 1906.

"The fruits from which these seeds were taken were of excellent quality, those of Nos. 19379 and 19380 being exceptionally fine. The quality of No. 19380 was, I think, the finest of any avocado I have tasted, notwithstanding its long journey in cold storage to San Francisco, express from there to Lodi, iced car from there to New York, and express from New York to Washington. which variable temperature and surroundings are, of course, likely to injure the flavor and quality of any such fruit." (*Taylor.*)

19382. VITIS VINIFERA. **Grape.**

From Quetta, Baluchistan. Received through Mr. Frank Benton April 6, 1906.

"(No. 43.) Cuttings of a variety of grape described by the natives as large and white." (*Benton.*)

19383. CYNARA SCOLYMUS. **Artichoke.**

From Algiers, Algeria. Received through Dr. L. Trabut November 14, 1906.

Violet Provence, "race precoce" (early strain).

19384. CHRYSOPHYLLUM MAGALIS-MONTANA.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, of the Department of Agriculture. Received November 14, 1906.

"This is an ornamental evergreen shrub or small tree of the family Sapotaceae, common on stony outcrops, particularly in the 'Middle Veld' (below 4,000 feet altitude); and also on frostless ridges at about 6,000 feet near Johannesburg. It would appear to be sensitive to frost. The fruit is agreeably acidulous and most refreshing in hot weather. It is much used by the natives for making a 'Kaffir beer' and by the white people for preserves, jelly, and a kind of brandy. The 'pit' is too large, but perhaps this defect can be improved away. In any case, the tree is worth growing for ornament.

"In the 'Taal' it is called *Stem-vrugte*, because the fruit is borne nearly sessile on the stem and main branches.

"The tree tolerates great heat and light rainfall, say, 14 inches falling only in summer, with cold nights during winter and little or no rain for about six months." (*Davy.*)

19385. CITRUS DECUMANA. **Pomelo.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, November 13, 1906.

"Native *Lukban*, or pomelo, similar to that last sent (S. P. I. No. 19292); selected from a tree of more than ordinary prolificacy and superior fruit." (*Lyon.*)

19386. CASUARINA EQUISETIFOLIA. **Beefwood.**

From Manila, P. I. Received through Mr. W. S. Lyon, of the Bureau of Agriculture, November 13, 1906.

"*Agoho.* Hardwood timber of rapid growth; endures, with us, remarkable extremes of drought and moisture." (*Lyon.*)

19387 and 19388. CYNARA SCOLYMUS. **Artichoke.**

From Paris, France. Received through Vilmorin-Andrieux & Co., November 13, 1906.

19387. *Large Globe* or *Paris.* 19388. *Large Flat Brittany.*

19390 to 19419.

From China. Received through Mr. F. N. Meyer, agricultural explorer, at the Plant Introduction Garden, Chico, Cal., in the spring of 1906.

A collection of seeds, as follows:

19390. GINKGO BILOBA. **Ginkgo.**

From Western Hills, near Peking. "(No. 54a, Nov., 1905.) A fine, spreading tree with leaves less strongly lobed than generally met with. Collected in an old temple garden." (*Meyer.*)

19390 to 19419—Continued.

19391. PISTACIA CHINENSIS.

From Wei-tsan Mountains, near Peking. "(No. 63a, Nov., 1905.) A very ornamental tree, growing to quite large dimensions; graceful outlines; large pinnate leaves; small leaflets. The carpellate trees apparently do not grow so large as the staminate trees; fruits very small. May be a good stock for the large-fruited pistaches." (*Meyer.*)

19392. QUERCUS sp.

From Chang-li. "(No. 64a, Oct. 13, 1905.) An ornamental oak with broad, glossy leaves; very much used for building purposes. Grows wild in the mountains." (*Meyer.*)

19393. QUERCUS sp. **Oak.**

From Chang-li. "(No. 65a, Oct. 11, 1905.) A slender growing oak with rather long, serrated leaves looking somewhat like chestnut leaves. Used for poles and building material. Grows wild in the mountains near Chang-li." (*Meyer.*)

19394. ZIZYPHUS SATIVA. **Jujube.**

From Peking. "(No. 91a, Oct., 1905.) Seeds of a very large variety of 'date' sold in the market. These fruits are well worth growing, tasting very sweet when dried, and are also nice to eat when fresh." (*Meyer.*)

19395. DIOSPYROS LOTUS. **Persimmon.**

From Wei-tsan Mountains, near Peking. "(No. 94a, Nov., 1905.) A large variety of the wild persimmon; otherwise the same description applies to it as that given for No. 57a, S. P. I. No. 17906." (*Meyer.*)

19396. LAGENARIA VULGARIS. **Gourd.**

From Hwai jou. "(No. 97a, Nov. 6, 1905.) A pear-shaped gourd used for covering trellises." (*Meyer.*)

19397. ZIZYPHUS SATIVA. **Jujube.**

From Pee-san. "(No. 98a, Oct. 26, 1905.) Seeds of an elongated fruited variety of the 'date;' very sweet and a heavy bearer." (*Meyer.*)

19398. LAGERSTROEMIA INDICA. **Crape myrtle.**

From Western Hills. "(No. 102a, Nov., 1905.) Seeds of dark purple crape myrtles growing in old temple gardens." (*Meyer.*)

19399. KOELREUTERIA PANICULATA. **Varnish tree.**

From Wei-tsan Mountains, near Peking. (No. 103a, Nov., 1905.)

19400. EUONYMUS sp.

From Tang-san. "(No. 110a, Oct. 25, 1905.) A very ornamental shrub loaded in the fall with white capsules and scarlet berries." (*Meyer.*)

19401. AMPELOPSIS TRICUSPIDATA. **Boston ivy.**

From Wei-tsan Mountains, near Peking. "(No. 112a, Nov., 1905.) Should not be planted in a southern exposure unless shaded; where found wild they seem to prefer the northeast and also, although in a less marked degree, the northwest." (*Meyer.*)

19402. QUERCUS sp. **Oak.**

From Shan-hai-kwan. "(No. 114a, Oct. 17, 1905.) A slender oak with very narrow leaves; produces good poles." (*Meyer.*)

19403. DIOSPYROS KAKI. **Persimmon.**

From Peking. "(No. 121a, Oct. 2, 1905.) Seeds of a medium-sized persimmon, not much seen for sale here." (*Meyer.*)

19390 to 19419—Continued.

19404. Albizzia julibrissin.

From Tang-san. "(No. 131a, Oct. 25, 1905.) A small-sized ornamental tree with very finely divided pinnate leaves; bears pinkish blossoms." (*Meyer.*)

19405. Crataegus pinnatifida. **Hawthorn.**

From Tientsin. "(No. 147a, Nov. 22, 1905.) A large-fruited variety used for making very fine preserves. The trees are decidedly ornamental and highly deserve to be planted in parks in groups or as solitary specimens. See also No. 52a (S. P. I. No. 17882)." (*Meyer.*)

19406. Prosopis sp. ? **Mesquite bean.**

From Honolulu, Hawaii. "(No. 150a, Sept. 9, 1905.) A shrub which supplies in its pods an excellent cattle food. Its wood is fine firewood, and when used for fence posts will last a long time. Grows on sandy or on dry wastes where nothing else will grow." (*Meyer.*)

19407. Rhamnus sp. **Buckthorn.**

From Shan-hai-kwan. "(No. 175a, Dec. 1, 1905.) A small Rhamnus growing from 3 to 5 feet high; has small leaves which turn to bronze hues in the fall. Might be of use as a small hedge plant, as the stems grow close together and are well furnished with spines." (*Meyer.*)

19408. Cinnamomum camphora. **Camphor tree.**

From Tang-hsi, near Hanchau, Chehkiang. "(No. 220a, Feb. 28, 1906.) Seeds of some fine old camphor trees growing wild and also cultivated." (*Meyer.*)

19409. Quercus sp. **Oak.**

From Hanchau. "(No. 222a, Mar. 3, 1906.) A few acorns of a tall, deciduous oak used for building purposes." (*Meyer.*)

19410. Rhus sp. **Sumac.**

From Hanchau. "(No. 223a, Mar. 4, 1906.) Seeds of a sumac growing wild in the woods. Grows to a medium-sized tree when left alone, but on account of being chopped off is usually found as a bush." (*Meyer.*)

19411. Acer sp.

From near Hanchau. "(No. 225a, Mar. 6, 1906.) A very tall growing maple well adapted for use as an avenue tree." (*Meyer.*)

19412. (Undetermined.)

From Tang-hu. "(No. 226a, Mar. 1, 1906.) A vine growing along a hedge; may be an ornamental." (*Meyer.*)

19413. Lonicera japonica. **Honeysuckle.**

From Tang-hsi. "(No. 227a, Feb. 28, 1906.) A large-leaved variety." (*Meyer.*)

19414. Caesalpinia sp. (?).

From Tang-hsi, near Hanchau. "(No. 229a, Mar. 1, 1906.) A very tough timber-producing tree used for making ax and spade handles. Seems to be a Caesalpinia or something closely related." (*Meyer.*)

19415. (Undetermined.)

From Tang-hsi. "(No. 230a, Mar. 1, 1906.) A bush which may prove to be ornamental; often becomes a small tree. Cuttings sent under No. 147 (S. P. I. No. 18471)." (*Meyer.*)

19390 to 19419—Continued.

19416. (Undetermined.)

From Tang-hsi. "(No. 231a, Mar. 1, 1906.) An ornamental, very densely headed, evergreen tree, not growing to large dimensions; leaves are rather small, but glistening green; bears black berries in the spring. The trunk of the tree is exceedingly spiny. It may do as a hedge plant in the mild-wintered regions of the United States." (*Meyer.*)

19417. SOLANUM DULCAMARA. **Nightshade.**

From Wei-tsan Mountains, near Peking. "(No. 233a, Nov., 1905.) A climbing, hardy, perennial Solanum, sometimes used as an ornamental vine." (*Meyer.*)

19418. CLERODENDRON BUNGEI.

From Chang-li. "(No. 234a, Nov., 1905.) Black seeds given to me as being of an ornamental shrub." (*Meyer.*)

19419. GLEDITSIA sp.

From near Hanchau. "(No. 235a, Mar. 6, 1906.) A tall-growing tree with wide-spreading branches. May prove to be an ornamental tree." (*Meyer.*)

19420. CITRUS DECUMANA. **Pomelo.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, November 19, 1906.

"*Pomelo de China Lukban*, a pomelo of superior quality, though slightly seedy." (*Lyon.*) (See also S. P. I. Nos. 19292 and 19385.)

19421 to 19423.

From Bangkok, Siam. Presented by His Excellency, Phya Akharaj Varadhara, minister of Siam to the United States. Received November 19, 1906.

19421 and 19422. DIOSCOREA sp. **Yam.**

Man Sow.

19423. IPOMOEA BATATAS. **Sweet potato.**

Man-thes.

"These yams are used by the people of Siam in much the same manner that ordinary potatoes are used in the West, i. e., they are boiled, fried, and roasted. The sprouts are cut off with a little of the body of the yam and planted. From this the new plant develops." (*Edward Loftus, private secretary, Siamese Legation.*)

19425 to 19428.

From northern Korea and Siberia. Received through Mr. F. N. Meyer, agricultural explorer, November 13, 1906.

19425. ZOYSIA PUNGENS. **Korean lawn-grass.**

From near Ai-djou, north Korea. "(No. 470a, July 15, 1906.) A perennial grass growing but a few inches high, well adapted for lawn purposes. Needs mowing, in all probability, but once or twice a year and requires very little water. This grass was found in a very dry, exposed situation. Probably a very valuable grass." (*Meyer.*)

19426. ZOYSIA PUNGENS. **Korean lawn-grass.**

From the banks of the Yalu, northern Korea. "(No. 471a, July 27, 1906.) The same grass as No. 470a (S. P. I. No. 19425), but from a moister locality. There were donkeys continually browsing upon this grass and considerable walking over it, but it was one green velvet turf, and as such will be excellent for golf links, lawns, etc." (*Meyer.*)

19425 to 19428—Continued.

19427. JUNCUS sp. **Rush.**

From near Vladivostok, Siberia. "(No. 513a, Oct. 5, 1906.) A rush found growing in low, wet places in heavy, clayey soil. Has long, straight leaves from 3 to 4 feet long. Will probably be very valuable for matting manufacturing purposes. Can be grown far north. Sow the seeds on sterilized peaty soil. Keep the seed pot in a saucer of water and cover with glass." (*Meyer.*)

19428. JUNCUS sp. **Rush.**

From near Vladivostok, Siberia. "(No. 514a, Oct. 6, 1906.) A rush found growing on rather dry soil; in all probability adapted for matting manufacture. Can probably be grown without standing water. Plants sent under Nos. 557 and 558 (S. P. I. No. 19480)." (*Meyer.*)

19429. PANICUM CRUS-GALLI. Barnyard grass.

From Tegucigalpa, Honduras. Received through Dr. R. Fritzgartner, November 14, 1906.

"Locally called *Camalote*. This grass, or cane, grows very rapidly up to 7 or 8 feet in damp places. We have it here at a height of 6,000 feet, as well as on the coast, where it grows wild. The plant is one of the best nourishing grasses and is preferred by cattle and horses to any other plant we have here. The animals become very fat on it, and the plant is eaten up whether dry or fully grown. It is different from Honduras teosinte." (*Fritzgartner.*)

19430. JOANNESIA PRINCEPS.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director, Agricultural College. Received June 7, 1906.

"(No. 19.) A large tree furnishing fine timber." (*Hart.*)

19457 to 19465.

From Moyabamba, Peru. Presented by Mr. Serafin Filomeno. Received November 12, 1906.

Seeds as follows, with notes by Filomeno:

19457. (Undetermined.) **Rubber.**

Mazaranduba, cultivated rubber.

19458. (Undetermined.) **Rubber.**

Monisoba, cultivated rubber.

19459. (Undetermined.) **Rubber.**

Yebe de Caballo Cocha, from Loreto.

19460. (Undetermined.) **Rubber.**

Yebe de Balsapuerto.

19461. (Undetermined.) **Rubber.**

Leche Caspi. Wild rubber discovered by Mr. Filomeno.

19462. (Undetermined.) **Rubber.**

Guta Moyobombi; not very abundant in resin; discovered by Mr. Filomeno.

19463. GOSSYPIUM sp. **Cotton.**

Brown-fibered cotton.

19464. GOSSYPIUM sp. **Cotton.**

White-fibered cotton.

19465. ZEA MAYS. **Corn.**

A red variety.

19467 and 19468.

From Hoijo, near Kobe, Japan. Received through Mr. John Tull, special agent, November 13, 1906.

19467. RAPHANUS SATIVUS. **Radish.**

"(No. 2.) This is the large white radish that is used so extensively by the Japanese. It is grated and served raw, as horseradish is, with meats, and is also cut up into small blocks about 1 inch square and pickled. I did not see it eaten raw in any large quantity, as we do the radish." (*Tull.*)

19468. PHASEOLUS ANGULARIS. **Adzuki bean.**

"(No. 3.) A small red bean, supposed to mature three months after planting. The Japanese make a candy or cake, called *azuki*, *shiyozu*, and *yowkau*, from these beans, which, when served with tea, is very refreshing, palatable, and satisfying. They boil the beans thoroughly; then by mixing them with water the preparation is strained through a fine cloth, separating the hulls. The bean part settles and leaves the water on top. The water is then poured off and the bottom, being mixed with sugar to the proper proportion, is boiled again and when cool hardens. It is then cut into small pieces 1 inch square and served." (*Tull.*)

19469 to 19480.

From eastern Siberia. Received through Mr. F. N. Meyer, agricultural explorer, November 24, 1906.

A collection of cuttings of trees and shrubs and roots of rushes, as follows:

19469. SALIX sp. **Willow.**

From near Vladivostok. "(No. 537, Oct. 6, 1906.) A very tall growing willow with small, narrow leaves. Similar to No. 529 (S. P. I. No. 19527)." (*Meyer.*)

19470. SALIX sp. **Willow.**

From near Vladivostok. "(No. 538, Oct. 6, 1906.) A bushy willow having long, slender branches and long, narrow leaves. Seems to be sand binding and forms dense thickets here and there along the Yalu." (*Meyer.*)

19471. SALIX sp. **Willow.**

From near Vladivostok. "(Nos. 539 and 540, Oct. 6, 1906.) A low, somewhat crawling willow with broad, short leaves, found in a dry creek bed. Is very tough and can probably be utilized as a sand binder and also for basket making." (*Meyer.*)

19472. SALIX sp. **Willow.**

From Okyansky. "(Nos. 541 and 542, Oct. 8, 1906.) A very tall growing willow with large, broad leaves. This is probably a variety of No. 537 (S. P. I. No. 19469)." (*Meyer.*)

19473. SALIX sp. **Willow.**

From Okyansky. "(No. 543, Oct. 9, 1906.) A tall-growing, bushy willow, making straight shoots 8 feet long. May be of use in basket making. Grows on rather dry land and is in all probability a hybrid." (*Meyer.*)

19474. SALIX sp. **Willow.**

From near Sedansk. "(Nos. 544 and 545, Oct. 7, 1906.) A low, bushy willow with very slender, tough branches having red-colored bark. An excellent tying material for use in the garden. Seems to prefer somewhat wet situations." (*Meyer.*)

19469 to 19480—Continued.

19475. SALIX sp. **Willow.**

From near Sedansk. "(No. 546, Oct. 7, 1906.) A broad-leaved willow, growing mostly as a shrub, but seen here and there as a small tree; is found in very dry situations and usually between other shrubbery." (*Meyer.*)

19476. ACANTHOPANAX SESSILIFLORUM.

From near Sedansk. "(Nos. 547, 548, 549, and 550, Oct. 7, 1906.) An ornamental, hardy shrub, having palmately divided leaves and bearing on its somewhat spiny branches many short, dense umbels of brownish colored flowers, followed by blackish berries. Throws out many shoots from the roots, which do not fall in all directions, as many of our garden shrubs do." (*Meyer.*)

19477. VITIS AMURENSIS. **Grape.**

From near Sedansk. "(Nos. 551 and 552.) Wild grapes, bearing small bunches of edible berries, found in dry and exposed places between shrubbery. They will probably prove to be a good stock in regions where climatic conditions are not favorable for grape culture." (*Meyer.*)

19478. FRAXINUS sp. **Ash.**

From Okyansky. "(Nos. 553 and 554, Oct. 9, 1906.) A large-leaved ash, of use as an ornamental tree in parks and large gardens." (*Meyer.*)

19479. ACTINIDIA KOLOMIKTA (?).

From the mountains near Okyansky. "(Nos. 555 and 556, Oct. 8, 1906.) A tall, climbing actinidia, producing silver-tinted leaves among its masses of foliage." (*Meyer.*)

19480. JUNCUS sp. **Rush.**

From near Vladivostok. "(Nos. 557 and 558, Oct. 6, 1906.) A rush growing on rather dry ground. Seems to be a very good one for matting manufacture. If so, could probably be grown in ordinary fields for this purpose and would, as such, do away with all the difficulties connected with the culture of wet-land rushes." (*Meyer.*)

19482. TRITICUM VULGARE. Wheat.

From Histon, Cambridge, England. Presented by Prof. R. H. Biffen, of the Cambridge University Agricultural Experiment Station, through Prof. N. E. Hansen. Received November 1, 1906.

19484. CELTIS RHAMNIFOLIA. Cambedoo stinkwood.

From Cape Town, South Africa. Presented by Mr. E. Hutchins, Conservator of Forests at Cape Town, through Prof. A. V. Stubenrauch, Berkeley, Cal. Received at the Plant Introduction Garden, Chico, Cal., December 2, 1905.

19485. ANDROPOGON RUFUS.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College. Received November 20, 1906.

19486. CANNABIS SATIVA. Hemp.

From Lexington, Ky. Received through Prof. H. Garman, of the Agricultural Experiment Station, November 30, 1906.

This seed is the first generation from Manchurian hemp seed produced in the district of Shinmintong, some 200 miles southwest of Kirin Province, and was grown from S. P. I. No. 18632 at the Agricultural Experiment Station, Lexington, Ky., during the season of 1906. The original seed from which this seed was grown was received May 29, 1906, from the Yokohama Nursery Company, Yokohama, Japan.

19488. CANANGA ODORATA. **Ilang Ilang.**

From Hacienda Malunu, near Ilagan, Isabela, P. I. Presented by Mr. George P. Ahern, Director of Forestry, through Mr. David Fairchild. Received December 1, 1906.

(See S. P. I. No. 20908 for remarks.)

19489. PRUNUS ARMENIACA. **Apricot.**

From Kwang-ning, Manchuria. Received through Mr. F. N. Meyer, agricultural explorer, October 24, 1906.

"(No. 265a.) Seed of the common wild apricot, which grows all over the mountains near Kwang-ning. The natives use the seeds in giving some flavor to the water in which they boil certain cakes, but they say the seeds are quite poisonous." (*Meyer.*)

19493 to 19495. GLADIOLUS spp. **Gladiolus.**

From Kew, England. Presented by Dr. David Prain, director, Royal Botanic Gardens. Received November 27, 1906.

Bulbs of wild species for use in hybridization experiments being conducted by Mr. T. H. Kearney.

19493. GLADIOLUS DRACOCEPHALUS.

19494. GLADIOLUS PURPUREO AURATUS.

19495. GLADIOLUS SEGETUM.

19496. INDIGOFERA ARRECTA.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, of the Department of Agriculture. Received November 19, 1906.

19497. DIOSPYROS VIRGINIANA. **Persimmon.**

From Blairstown, Md. Presented by Mr. W. S. Swart. Received November 27, 1906.

Cuttings of a seedless variety.

19498. CLERODENDRON FOETIDUM.

From Wönsan, Korea. Presented by Mr. C. F. S. Bilbrough. Received October 22, 1906.

"Seeds of a shrub from which the Koreans make their far-famed paper. This is a very hardy, handsome shrub and will grow from cuttings, seeds, or root sets up to about 20 feet. The Koreans macerate the bark in hot water to a pulp and from the proceeds make a very strong paper." (*Bilbrough.*)

(Probably the same as S. P. I. No. 12768.)

19499. LEUCADENDRON ARGENTEUM. **Silver tree.**

From Cape Town, South Africa. Presented by Mr. J. Wm. Lister, Acting Chief Conservator of Forests, Department of Agriculture. Received December 1, 1906.

(See S. P. I. Nos. 7556, 8317, and 9633.)

19500 and 19501.

From Ispahan, Persia. Received through Mr. John Tyler, U. S. vice consul general, Teheran, November 13, 1906.

19500. GLYCYRRHIZA GLABRA.

"The licorice grows wild and is largely exported to America, chiefly, I believe, for sweetening tobacco and possibly for mixing with porter." (*Tyler.*)

19500 and 19501—Continued.

19501. RUBIA TINCTORUM. **Madder.**

"The madder, as you know, produces the red color used in Persia for dyeing the wool of which the red of the carpets is woven. I have a little rug in my house, upward of a hundred years old, of this dye, which is as bright now as when it was first woven. The Turkey reds were originally dyed from this root." (*Tyler.*)

19502. ASPARAGUS SCHOBERIOIDES.

From Yokohama, Japan. Received through the Yokohama Nursery Company December 1, 1906.

Imported for experiments in the breeding of disease-resistant asparagus.

19503. AVENA FATUA.

From Ispahan, Persia. Received through Mr. John Tyler, U. S. vice consul general, Teheran, November 13, 1906.

"Seed found growing wild in the province of Ispahan, about 270 miles from Teheran, Persia." (*Tyler.*)

19504. CITRUS DECUMANA. **Pomelo.**

From Shanghai, China. Presented by Mr. J. R. Huffaker, Brookfield, Mo. Received December 10, 1906.

"Seeds collected by Prof. W. A. Estes, 18 Quinsan road, Shanghai, China." (*Huffaker.*)

19505. CELTIS AUSTRALIS. **Hackberry.**

From Tunis, Tunis. Presented by Mr. L. Guillochon, Director of Agriculture. Received December 4, 1906.

"One of the best avenue and shade trees in use in North Africa and Portugal." (*Fairchild.*)

19506 and 19507. TRIFOLIUM SUAVEOLENS. **Clover.**

From northwestern India. Presented by Mr. Philip Parker, of the Indian Irrigation Service, through Mr. C. J. Brand, December 10, 1906.

19506.

Daur Shaftal. "This variety comes from the Tochi Valley, where it is commonly sown during the month of September and gives three cuttings of hay after December. This is probably one of the upright forms of *Trifolium repens*, similar to the one grown in the Po Valley, of northern Italy." (*Scofield.*)

19507.

Farsi Shaftal (Persian clover.) "This seed was obtained from Pannu (or Edwardesabad). No cultural notes accompanied this sample, but it is believed to be similar to the *Daur Shaftal.*" (*Scofield.*)

"This species has been somewhat sparingly cultivated in European gardens on account of its fragrant pale-rose flowers. The seed sometimes occurs as an impurity in alfalfa, and when thus sown with alfalfa in the fall has been found to withstand the winters at Washington, D. C., perfectly. It is possible that this clover will be found useful for sowing in the late summer or early fall, after the manner of crimson clover. It shows, however, a great tendency to lodge badly on account of the weak, hollow stems." (*C. V. Piper.*)

19509 to 19511. MUSA spp.

From Santa Barbara, Cal. Presented by Dr. F. Franceschi, through Mr. O. W. Barrett. Received December 11, 1906.

19509. MUSA MARTINI.

19510. MUSA RHODOCLAMYS.

19511. MUSA ENSETE.

19512. HORDEUM HEXASTICHUM. Six-row barley.

From Guelph, Ontario, Canada. Received from Prof. J. Buchanan, through Prof. C. A. Zavitz, November 27, 1906.

"A pedigreed barley of the Manchurian type; said to be an excellent producer." (*Zavitz.*)

19513 and 19514. CAPSICUM ANNUUM. Red pepper.

From Tientsin, China. Received through Mr. F. N. Meyer, agricultural explorer, April 23, 1906.

19513.

A large, short-podded variety.

19514.

A long, narrow-podded variety.

19516. ASPARAGUS ACUTIFOLIUS.

From Nice, France. Presented by Dr. A. Robertson Proschowsky. Received December 12, 1906.

"I have continually been on the lookout for seedlings of *Asparagus acutifolius* L., the native species here, the tender shoots of which are eagerly gathered as a delicacy, but the plant is rather scarce in the little wood belonging to me, and it is, I believe, impossible to transplant it, at least when it, as here, grows in the rocks, sending its fleshy roots deep in the fissures. Young plants are exceedingly scarce, as are the seeds, and then it seems even the few seeds produced are destroyed by insect enemies.

"I nearly gave up the hope of finding young plants, and then going through the pot cultures I came on a plant which was growing in a pot. I have always given orders to save seedlings of this species when found working in the ground, and it must be such a plant. Thus it has come that at last I have had the great pleasure of being able to send you plants undoubtedly true to name. Perhaps you are right that even all the young seedlings I sent are also *A. acutifolius*, though I thought they were not." (*Proschowsky.*)

19517 to 19521.

From Alexandria, Egypt. Presented by Mr. V. F. Naggiar, through Mr. David Fairchild, November 6, 1906.

19517. ANDROPOGON SORGHUM. Sorghum.

19518. ANDROPOGON SORGHUM. Sorghum.

19519. CICER ARIETINUM. Chick-pea.

19520. VICIA FABA. Horse bean.

19521. TRIGONELLA FOENUM-GRAECUM. Fenugreek.

19523 to 19531.

From Manchuria, Korea, and eastern Siberia. Received through Mr. F. N. Meyer, agricultural explorer, December 1, 1906.

A collection of seeds, cuttings, and plants, the latter distinguishable from the seeds by the absence of the letter "a" following Meyer's number.

19523 to 19531—Continued.

19523. Juncus sp. **Rush.**

From northern Korea. "(No. 472a, Sept. 2, 1906.) Seed of a Juncus found growing in a wet ditch; looks like *J. effusus*, but has longer, more slender leaves. Probably very valuable in matting manufacture. Will grow very far north, as the climate here is pretty cold in winter. Sow under glass on wet, peaty soil." (*Meyer.*)

19524. Juncus sp. **Rush.**

From near Novo Kiowsk, Siberia. "(No. 473a, Sept. 10, 1906.) A Juncus with slender leaves growing to be a yard long; found on salty, marshy land. May be valuable for matting manufacture. Sow the same as No. 472a (S. P. I. No. 19523)." (*Meyer.*)

19525. Scirpus sp.

From near Hunchun, Manchuria. "(No. 474a, Sept. 9, 1906.) A very tall Scirpus with leaves 4 to 5 feet long; found on marshy, peaty land. Sow the same as No. 472a." (*Meyer.*)

19526. Juncus sp. (?). **Rush.**

From northern Korea. "(No. 475a, Sept. 6, 1906.) A Juncus-like plant found growing in muddy, submerged places. Probably too short for matting manufacture, as it grows only about a foot tall. Sow the same as No. 472a." (*Meyer.*)

19527. Salix sp. **Willow.**

From the mountains of northern Korea. "(No. 529, Sept. 1, 1906.) A very fine, valuable willow, being an ornamental tree as well as a lumber producer. Attains a height of from 80 to 100 feet. When young the bark is white coated like *Eucalyptus globulus;* when old it becomes shaggy and can be torn off in strips. Seed sent under No. 403a (S. P. I. No. 20128)." (*Meyer.*)

19528. Actinidia kolomikta (?).

From the mountains of northern Korea. "(No. 530, Aug. 24, 1906.) Cuttings of an Actinidia having red and rosy colored leaves. This is a very ornamental climber, some of the leaves remaining light green, while others are wholly or partly colored." (*Meyer.*)

19529. Pinus koraiensis. **Pine.**

Young trees. From the forest of Bo-tau-shan, northern Korea. "(No. 533, Aug. 24, 1906.) A pine having bluish green foliage and bearing heavy cones, which contain edible seeds. This pine attains a height of over 150 feet; produces excellent lumber, making clean stems of 100 feet. May be of use for forestry or park purposes in the colder, moister regions of the United States. Cones sent under No. 333a (S. P. I. No. 20089)." (*Meyer.*)

19530. Larix sp. **Larch.**

Young trees. From the forest of Bo-tau-shan, northern Korea. "(No. 534, Aug. 24, 1906.) A larch growing to enormous dimensions, the trunk of some specimens being 4 feet in diameter 5 feet above the ground and over 150 feet tall. Produces excellent lumber. May be of use for forestry purposes and in parks in the colder regions of the United States." (*Meyer.*)

19531. Populus sp. **Poplar.**

Young tree. From the forest of Bo-tau-shan, northern Korea. "(No. 536, Aug. 25, 1906.) A poplar with large, elliptical leaves, of which the upper side is somewhat silvery. Grows to be a stately tree over 100 feet tall. Is used by the Koreans, when hollowed out, for making canoes and barrels. Of use as a forest and park tree in the cooler parts of the United States; likes a moist soil and thrives on sandy flats better than in a rocky situation." (*Meyer.*)

19532 to 19543.

From Valuiki, Samara Government, Russia. Presented by Mr. Vasili S. Bogdan, director, Kostichev Agricultural Experiment Station, through Prof. M. Golenkin, director, Moscow Botanical Gardens, Moscow, Russia. Received December 12, 1906.

19532. GLYCERIA DISTANS.

19533. FESTUCA OVINA.

19534. MEDICAGO FALCATA.

19535. POA BULBOSA VIVIPARA.

19536. AGROPYRON CRISTATUM.

19537. AGROPYRON DESERTORUM. (No. 1.)

19538. AGROPYRON DESERTORUM. (No. 2.)

19539. AGROPYRON DESERTORUM. (No. 3.)

19540. AGROPYRON DESERTORUM. (No. 4.)

19541. AGROPYRON DESERTORUM. (No. 5.)

19542. AGROPYRON TRITICEUM.

19543. AGROPYRON REPENS.

19544 to 19547. PHOENIX DACTYLIFERA. Date.

From Muscat, Arabia. Presented by the Hills Brothers Company, New York, N. Y. Received December 1, 1906.

Date seeds for propagating seedling date orchards in the Southwest.

19544. *Burdi.*

19545. *Burni.*

19546. *Khanaizi.*

19547. *Naghal.*

19548 and 19549. HORDEUM DISTICHUM. Barley.

From Wordsley, Stourbridge, England. Received through Edward Webb & Sons, November 14, 1906.

19458. *Webb's Kinver Chevalier.*

19549. *Webb's New Burton Malting.*

19550 to 19553. LILIUM spp. Lily.

From Shanghai, China. Presented by Rev. J. M. W. Farnham, D. D. Received December 18, 1906.

19550. (Bulbs.) 19551. (Seed.)

"This lily grows 6 or 7 feet high and bears a beautiful cream-colored flower resembling what I have heard called the Japan lily; ten or more flowers in one head." (*Farnham.*)

19552. (Bulb.) 19553. (Seed.)

"This lily came up in the spring, looking somewhat like a very large bean plant, with two leaves. It grew to be 3½ feet tall. The leaves, thick and large, were not opposite. Long before it bloomed a bud appeared, which gradually developed and finally opened, revealing 4 buds. From being erect, they began to turn down after the manner of the Japan lily (?), and when horizontal they bloomed. Each flower had 5 petals 6 inches long; 5 stamens. The stalk was one-half inch in diameter. The petals white, with a patch through the middle 2 inches long and three-fourths inch wide, reddish brown or claret color. Some of the leaves, including stem, were 10 inches long and 5 inches wide. The flowers were fragrant and had this peculiarity—the 4 lower petals were like a tube or box, the upper one resembling a cover or lid." (*Farnham.*)

19554 to 19557.

From Grensholmen, Norsholm, Sweden. Received from Baron J. Mannerheim, December 14, 1906.

Seed obtained for the purpose of testing at the Agricultural Experiment Station, Sitka, Alaska.

19554 to 19557—Continued.

19554. BRASSICA RAPA. **Turnip.**

Petrowski Russian. "Is proving resistant in Alaska to the turnip root maggot." (*Fairchild.*)

19555. BRASSICA RAPA. **Turnip.**

Gratscheffs Russian.

19556. SECALE CEREALE. **Rye.**

From northern Sweden.

19557. HORDEUM VULGARE. **Barley.**

From northern Sweden.

19561 and 19562. CRAMBE MARITIMA. **Sea kale.**

From Reading, England. Received through Sutton & Sons, December 20, 1906.

19561.

Ivory White. Plants.

19562.

Plants of ordinary sea kale.

For general distribution in an endeavor to popularize this delicious vegetable.

19563 to 19565. RHEUM spp.

From Cornhill, Liverpool, England. Received through The Cooperative Bees, Ltd., December 20, 1906.

19563. RHEUM COLLINIANUM.

19564. RHEUM EMODI.

19565. RHEUM UNDULATUM.

Imported for cooperative hybridizing experiments.

19567. RHEUM hyb. **Rhubarb.**

From Paris, France. Received through Vilmorin-Andrieux & Co., December 22, 1906.

Hybride Florentin. (See note to preceding number.)

19568 to 19571. ZEA MAYS. **Corn.**

From Budapest, Hungary. Received through Mr. Edmund Mauthner, May 1, 1906.

Four varieties of Indian corn, as follows:

19568. *Pignoletto.* (No. 176.)

19569. *Cinquantino.* (No. 177.)

"Promising for southern California and Arizona." (*Fairchild.*)

19570. *Sze'kely.* (No. 178.)

19571. *Alcsuth.* (No. 179.)

19576 to 19579. MUSA SAPIENTUM. **Banana.**

From Mayaguez, Porto Rico. Received from the Agricultural Experiment Station, through Mr. O. W. Barrett, December 26, 1906.

19576.

Platano Macho.

19577.

Hamakua.

19578.

Cuatro-racimos.

19579.

Congo Punzera.

19581. RHEUM PALMATUM TANGHUITICUM. **Rhubarb.**

From Chester, England. Received through Dicksons' Nurseries, December 26, 1906.

Imported for cooperative work in hybridizing experiments.

19582 to 19585. SOLANUM TUBEROSUM. **Potato.**

From Moscow, Russia. Received from E. Immer & Son, through Prof. N. E. Hansen, December 27, 1906.

Four varieties of the coarse alcohol potatoes imported for experiments in alcohol-distillation work:

19582.

Woltmann.

19583.

Phoebus.

19584.

Charter.

19585.

Viol.

19586. IRIS OBTUSIFOLIA. **Iris.**

From Kew, England. Presented by Dr. David Prain, director, Royal Botanic Gardens. Received December 29, 1906.

Plants imported for cooperative experiments.

19594 to 19596. RICINUS COMMUNIS. **Castor-oil plant.**

From Moyobamba, Peru. Presented by Mr. Serafin Filomeno, November 12, 1906.

Three types of seed distinguishable as to color and size.

19597 to 19605.

From eastern Siberia. Received through Mr. Frank N. Meyer, agricultural explorer, January 3, 1907.

A collection of plants and cuttings, as follows:

19597. JUNCUS sp. **Rush.**

From near Czernigowka, Siberia. "(Nos. 559 and 560, Oct. 22, 1906.) A rush growing in moist situations on black peaty soil. Can be grown in moisture-retaining soil without having to be flooded like the matting rushes in southern China. Seems to be well adapted for matting manufacture." (*Meyer.*)

19598. SALIX sp. **Willow.**

From near Iman, Siberia. "(Nos. 561 and 562, Nov. 1, 1906.) A broad-leaved willow growing to be a tall bush or small-sized tree; leaves somewhat hirsute. The branches of old trees assume a somewhat drooping habit. Is probably *Salix caprea.* Of use as a park shrub or tree, especially on dry, poor soils." (*Meyer.*)

19599. SALIX sp. **Willow.**

From Lake Hanka, Siberia. "(No. 563, Oct. 29, 1906.) A small-leaved willow growing in water 15 feet deep and having its main roots near the shore but sending out long shoots toward the deep water. The shoots stool out again and form floating bushes between the lotus leaves or the smaller bodies of water connected with the lake." (*Meyer.*)

19600. VITIS AMURENSIS. **Wild grape.**

From the mountains near Czernigowka, Siberia. "(Nos. 564 and 565, Oct. 23, 1906.) A variety bearing very large leaves; of use as a stock plant in cold climates for large-fruited varieties, and is possibly capable of sufficient improvement to give the world a perfectly hardy grape of the Vinifera type. An inferior wine is made from the berries." (*Meyer.*)

19597 to 19605—Continued.

19601. SALIX sp. **Willow.**

From Knorrink, Siberia. "(No. 566, Oct. 29, 1906.) A bushy willow making long, straight shoots. Grows on moist, peaty soil and is well fitted for basket making; has been planted by the Russians along some of the river banks, but is apparently not the best kind of willow for bank-binding purposes." (*Meyer.*)

19602. SCHIZANDRA CHINENSIS.

From Merkoechofka, Siberia. Cuttings and seed. "(Nos. 360a. 567, and 568, Oct. 25, 1906.) A climber bearing long racemes of scarlet berries which are edible, though not very good. The plant can be used as a graceful vine for trellis work and for porches." (*Meyer.*)

19603. MALUS MALUS. **Apple.**

From Khabarovsk, Siberia. "(No. 569.) A small, red-colored apple; withstands the cold and droughts in Khabarovsk very well. Called in Russian *Reinetka* apple, but it is of Chinese origin. Obtained from the garden of Gen. M. Vedensky." (*Meyer.*)

19604. PYRUS SINENSIS. **Pear.**

From Khabarovsk, Siberia. "(No. 570, Nov. 6, 1906.) Scions of an improved form of *P. ussuriensis*, the wild pear here; obtained from the garden of Gen. M. Vedensky." (*Meyer.*)

19605. PRUNUS sp. **Plum.**

From Khabarovsk, Siberia. "(No. 571, Nov. 6, 1906.) A yellow plum, said to be of good flavor, growing vigorously in the rather unfavorable climate. Obtained from the garden of Gen. M. Vedensky." (*Meyer.*)

19606 and 19607. CUMINUM CYMINUM. Cumin.

From Malta. Presented by Dr. J. Borg, curator, San Antonio Gardens. Received December 27, 1906.

"Samples of the best variety of cumin, *Kemmun bla sufa*, i. e., cumin without wool. Cumin has been grown in Malta since time immemorial. In Geoffroy's Materia Medica, published in Venice in 1742, it is stated that cumin *in Melita insula copiose seritur;* indeed, until recently it was not grown anywhere else in the Mediterranean. A peculiarity well worth mentioning is that cumin, although very largely grown in Malta, is never used by us in any way whatever, although we almost daily make use of anise seed, wild fennel, and caraway seed as condiments and for sweetmeats. Cumin is grown only to be exported to the continent, mostly to Hamburg, Germany. The price of cumin in ordinary years varies from £2 to £3 per kantar (Maltese hundredweight of 100 rotolo = 175 pounds). But this year, 1906, the price has gone up to £7 per kantar, said to be owing to the failure of the crop in Morocco. Cumin is used in Germany and Holland for the manufacture of some kinds of liquors and for flavoring dishes and pastry.

"Cumin is sown toward the end of March or beginning of April and the crop is ready toward the 15th of June. When it is about 1 inch high gangs of women are employed with small hoes who squat on the cumin and proceed to scratch the soil around it and to remove the weeds. They trample and bruise the cumin so much that it is a sorry sight to see a field of cumin just tilled, but the cumin seems to enjoy this treatment, and in a fortnight the bruised plants form into bushy balls of the deepest green, thickly set together and covered all over with umbels of small purplish flowers.

"We have two varieties of cumin, or rather the type and its variety. The typical cumin has the fruit or seed covered with longish downy hairs; the variety *bla sufa* is without hairs and is much less subject to mildew than the type. This is probably explained by the fact that the dew is retained by the hairs of the fruit and the growth of the fungus is favored. Both varieties are always found more or less mixed, as the beardless variety has a tendency to revert to the type, but to check the mildew our agriculturists are careful to

19606 and 19607—Continued.

discard as much as possible the bearded fruit. The presence of bearded seed does not affect the price of the crop. Cumin is little subject to diseases, much less so than anise, which is also much grown, but in moist springs is very liable to fail." (*Borg.*)

19608 to 19610. CITRUS spp.

From Glen Saint Mary, Fla. Propagated by Mr. G. L. Taber for distribution by the Office of Seed and Plant Introduction and Distribution. Numbered January 5, 1907.

Hybrid citrus fruits developed by Dr. H. J. Webber, in charge of the Department Plant Breeding Laboratory.

19608. CITRUS TRIFOLIATA × AURANTIUM. **Citrange.**

Rustic. (P. B. No. 783.) Budded on Trifoliata stock.

19609. CITRUS TRIFOLIATA × AURANTIUM. **Citrange.**

Colman. (P. B. No. 772.) Budded on Trifoliata stock.

19610. CITUBS NOBILIS × AURANTIUM. **Orange.**

Thornton. (P. B. Thornton No. 5.) Budded on rough lemon stock.

19611. GARCINIA MANGOSTANA. **Mangosteen.**

From Buitenzorg, Java. Presented by Dr. M. Treub, director, Department of Agriculture. Received January 5, 1907.

Seed.

19612. IMPATIENS OLIVERI.

From Kew, England. Presented by Dr. David Prain, director, Royal Botanical Gardens. Received January 5, 1907.

Seeds imported for breeding experiments.

19616. LAGENARIA VULGARIS. **Gourd.**

From Cape Town, South Africa. Presented by Hon. Horace Lee Washington, consul-general. Received December 20, 1906.

"Within the past five years there has come into very general use in South Africa a pipe made from the calabash. Pipe smokers who have used this calabash pipe, practically without exception, say that it gives a special softness of flavor that pipes of no other material offer. I believe this to be so and that the demand for such a pipe in the American market would be very large, for as soon as the pipe becomes known it will be appreciated. To be of benefit to the fullest extent the calabash should be grown at home.

"Great difficulty is experienced in securing the seed here. The farmers are sometimes suspicious and boil the seed, and in any event it is not readily obtained. The calabash pipe industry is proving a very remunerative one here in Cape Colony, both to the growers of the calabash and those engaged in making it into pipes, and also to the retail sellers. It grows in certain sections of Cape Colony with little difficulty, but seems to demand a very hot and dry climate with rain at the right season of the year to reach perfection. The curved stem end of the vegetable forms a light and appropriate shape for pipes. It colors like meerschaum and can be highly polished. The life of one of these pipes is about that of a French briar wood pipe. The usual lining is plaster of paris, called by the trade "meerschaum." A cheap grade is lined with tin. These pipes sell for from $1 to $62, according to the type of finish. Pipe mounting and fitting being cheaper in England than here, large shipments are made to England for mounting and returned here for sale.

"The industry is being crippled here by the growers refusing to sell the seeds of the calabash. It is extremely difficult, as stated above, to obtain them from any source. The crop last year was estimated at 60,000 and this year at about 150,000, but next season's prospects are not so good." (*Washington.*)

"This can be grown successfully in the Southwest, and gourds have been matured in Maryland from which beautiful pipes were made." (*Fairchild.*)

19617. CANAVALIA OBTUSIFOLIA.

From San Ramon, Mindanao, P. I. Received through Mr. Frank Benton, apicultural investigator, December 29, 1906.

"(No. 97.) Beans growing on the beach in sand wet with salt water from time to time. A creeping plant with ascending stems 18 inches to 2 feet tall; blossoms pinkish purple. Cattle eat the leaves readily. The plant binds well shifting sands close to sea water." (*Benton.*)

19618. LUFFA sp. **Gourd.**

From San Ramon, Mindanao, P. I. Received through Mr. Frank Benton, apicultural investigator, December 29, 1906.

(Benton's No. 98.)

19619. ANTIGONON LEPTOPUS. **Mountain rose.**

From Poona, Bombay Presidency, India. Received through Mr. Frank Benton, apicultural investigator, December 29, 1906.

"(No. 100.) Seed of a very ornamental climbing plant. Produces a profusion of beautiful delicate pink blossoms in branching racemes; commonly cultivated in parts of India; also common in Manila and other parts of the Philippines as a porch cover. Spanish name, *Cadena de Amor.*" (*Benton.*)

19620. HEDYCHIUM COCCINEUM (?).

From Lumding, Assam, India. Received through Mr. Frank Benton, apicultural investigator, December 29, 1906.

"(No. 101.) Seed of a herbaceous plant, 12 to 15 feet tall, found growing on the edge of a marsh. Leaves alternate, about 15 inches long, lanceolate-linear, pointed; blossoms in terminal racemes, each blossom resembling a small pink lily; quite ornamental; seed pods size of hazelnut, black when ripe; seeds numerous, small, black." (*Benton.*)

19621. OPUNTIA sp. **Tuna.**

From Alonzo, Mexico. Received through Dr. David Griffiths, January 7, 1907.

Seedling plants grown from seed collected by Dr. Griffiths June 10, 1904 (Nos. 6529 and 6530), at Alonzo, Mexico, and propagated in the Department greenhouse.

19622. PHYLLOSTACHYS MITIS. **Bamboo.**

From Nagasaki, Japan. Received through Mr. John H. Tull, special agent, January, 1907.

"Young plants of the *Moso* variety, which is the largest variety growing near Nagasaki. These plants were purchased from a farmer, Mr. Gaichiro Komori, 1313 Tagami village, and I know them to be genuine, as I saw them dug, and the roots were connected with the large plants. The true largest form is hard to dig, and unless some one is there when they are dug smaller forms will be substituted, for all look alike when young. Tagami village is only a few miles out and very fine bamboos grow there. One or two thousand more plants, grown one year in nursery rows, can be arranged for at 40 sen (20 cents) each, if desired." (*Tull.*)

19630 to 19691. MALUS spp.

From Jamaica Plain, Mass. Presented by Prof. C. S. Sargent, of the Arnold Arboretum. Received January 7, 1907.

A collection of cuttings secured from trees growing in the Arnold Arboretum for cooperative work with the Mississippi Valley Apple Breeders' Association.

The notes are those of Professor Sargent.

19630 to 19691—Continued.

19630. M. SARGENTI.

"*M. sargenti* was discovered by me in a salt marsh near Mororan, Japan, in 1892. It is a rather small shrub, but very ornamental in flower."

19631. M. SYLVESTRIS.

"*M. sylvestris* is sometimes called *M. aceba*, and by the older botanists was considered a form, at least, of the common apple."

19632. M. CRATAEGIFOLIA.

"*M. crataegifolia*, sometimes called Cormus, is a rare Italian tree."

19633. M. SPECTABILIS var. (1615).

"*M. spectabilis* var. is the double-flowered form of *M. spectabilis*, unknown in cultivation and supposed to be a native of China."

19634. M. ZUMI.

"*M. zumi* is a native of the mountains of Japan, where I found it in 1892 and introduced it into cultivation."

19635. M. BACCATA (?).

"*M. baccata* is the small-fruited crab of eastern Siberia."

19636. M. ATROSANGUINEA.

"*M. atrosanguinea* is probably a hybrid between *M. toringo* and *M. floribunda*."

19637. M. BACCATA × MALUS (3549).

19638. M. PRUNIFOLIA FRUTICO COCCINEA.

19639. M. DENTICULATA (4627–1).

19640. M. CASHMERICA (8833/1).

"*M. cashmerica* is a Himalayan species. It is growing well here and is interesting as one of the few Himalayan trees that flourish in this climate."

19641. M. CORONARIA.

"*M. coronaria* is our common species of the Eastern States."

19642. M. BACCATA SANGUINEA.

19643. M. SIBIRICA FRUTICO COCCINEA.

19644. M. MICROCARPA.

19645. M. MALUS, extra fruiting var.

19646. M. SCHEIDECKERI.

"*M. scheideckeri* is a very fine seminal form of the double *M. spectabilis*."

19647. M. SIBIRICA (?).

"Progress, Ottawa. Probably a baccata."

19648. M. BACCATA PRUNIFOLIA (2553).

19649. M. RIVULARIS var.

"*M. rivularis* var. is a very interesting plant, indeed, raised here from seed many years ago collected in Oregon. It is quite distinct from *M. rivularis* and gives some evidence of being a hybrid. It has not yet been described or named."

19650. M. PRUNIFOLIA.

Extra-red fruit. "*M. prunifolia* is a Siberian species."

19630 to 19691—Continued.

19651. M. ARNOLDIANA.

"*M. arnoldiana* is a seedling of *M. floribunda* that originated in the Arboretum and shows the influence of the blood of *M. prunifolia* by its larger flowers."

19652. M. TORINGO.

(Mountains, Peking; 1708.) "*M. toringo* is the common north China species, with both red and yellow fruits. Your No. 19664 is a dwarf form of this raised at the Arboretum from Chinese seeds."

19653. M. BACCATA OBLONGA (1785).

19654. M. TORINGO.

Yellow fruit (3703 F).

19655. M. PRUNIFOLIA XANTHOCARPA.

19656. M. FLORIBUNDA.

"*M. floribunda* is probably a Chinese plant, although it was introduced into Europe and the United States from Japan. It does not appear to be known in a wild state."

19657. M. SPECTABILIS var. (459–1).

19658. M. RINGO (4644).

"*M. ringo* is probably Japanese."

19659. M. SPECTABILIS.

19660. M. BACCATA var.

19661. M. BACCATA × FLORIBUNDA.

19662. M. RINGO.

19663. M. BACCATA AURANTIACO.

19664. M. TORINGO.

Dwarf variety; mountains near Peking.

19665. M. SOULARDI.

"*M. soulardi* is the well-known species, or hybrid, as some authors believe, of the Central West."

19666. M. BACCATA.

Var. Hillend; bright red fruits.

19667. M. MALUS.

Bright red fruit.

19668. M. RIVULARIS.

"*M. rivularis* is the common wild crab of the Northwest."

19669. M. MALUS (444–1).

19670. M. ASTRACANICA.

19671. M. MALUS. (441–2).

19672. M. PRUNIFOLIA RUBIA CERASIFORMIS.

19673. MALUS (?) var.

Rones crab (Ottawa).

19674. M. IOENSIS.

"*M. ioensis* is the common crab of the Central West."

19675. M. PRUNIFOLIA FLAVA.

19630 to 19691—Continued.

19676. M. ANGUSTIFOLIA.

"*M. angustifolia* is the crab apple of the Southern States, getting north into Missouri and Pennsylvania."

19677. M. BACCATA MAXIMA.

19678. M. MALUS × BACCATA.

19679. M. MALUS fl. pl.

19680. M. MALUS FASTIGIATA BIFERS (538–2).

19681. M. HALLIANA.

"*M. halliana*, of which *M. parkmani* is a synonym, is also Chinese, although it was probably first introduced from Japan. It is unknown in a wild state."

19682. M. BACCATA var.

19683. M. NIEDWETZSKYANA.

"*M. niedwetzskyana* is a Turkestan tree and probably a form of the common apple."

19684. M. SPECTABILIS var. (766–1).

19685. M. BACCATA × TORINGO.

19686. M. RINGO INCISA (3636–1).

19687. M. KAIDO.

19688. M. MALUS PENDULA.

"*M. pendula* is the weeping form of the common apple."

19689. M. RINGO SUBLOBATA (4645).

19690. M. PRUNIFOLIA MACROCARPA.

19691. MALUS sp. (5004 No. 5).

19692. ARALIA CORDATA. **Udo.**

From Japan. Received from Furuya & Co., Seattle, Wash., January 10, 1907 .

Moyashi. Plants of an especially vigorous strain.

19693 and 19694. SOLANUM COMMERSONI. **Aquatic potato.**

From Burlington, Vt. Received through Prof. Wm. Stuart, of the Agricultural Experiment Station, January 7, 1907.

19693.

"Field-grown tubers from stock of Rev. J. R. Lawrence, Middleboro, Mass., whose original stock came from Dr. Haeckel." (*Stuart.*)

19694.

"Greenhouse-grown tubers from stock secured direct from Dr. Haeckel in 1904." (*Stuart.*)

19695 and 19696. ANDROPOGON SORGHUM.

From Bloemfontein, Orange River Colony, South Africa. Presented by Mr. M. Stewart Galbraith, government agronomist, through Prof. C. V. Piper. Received January 14, 1907.

19695. **Kafir corn.**

"Common *Boer* Kafir corn; a white variety quite productive under our local conditions; being somewhat late, it is very drought resisting." (*Galbraith.*)

19695 and 19696—Continued.

19696. **Sweet sorghum.**

"*Sorghum saccharatum* supposed to have been brought to this country by the exile Boers who had been transported to Ceylon during the South African war. Unfortunately I can not speak definitely on this variety, as it has not had time to develop; however, the farmer from whom I obtained the seed speaks very highly of it as a bird-proof Kafir corn; that is to say, that this variety when grown beside the common *Boer* Kafir corn was immune to the ravages of birds, while the local variety was almost destroyed." (*Galbraith.*)

19714. PENNISETUM CENCHROIDES

From Ootacamund, India. Presented by Mr. R. L. Proudlock, curator, Government Botanic Gardens. Received January 8, 1907.

"Tamil name *Kolei-Kattei*. This grass is largely cultivated in the Coimbatore district for the purpose of pasturing cattle on. It is considered to be a valuable fodder and stands drought well." (*Proudlock.*)

19715. XANTHOSOMA SAGITTIFOLIUM. **Yautia.**

From Ancon, Canal Zone. Received through Mr. Henry F. Schultz, January 22, 1907.

19716. VANILLA sp. **Vanilla.**

From Las Animas, Mexico. Received from Don Ernesto Guterrez, through Mr. G. N. Collins, January 21, 1907.

"Cutting of a variety said to yield very good vanilla." (*Collins.*)

19717. OLIVERANTHUS ELEGANS.

From Central Mexico. Received through Dr. J. N. Rose, of the U. S. National Museum, January 21, 1907.

Discovered in Mexico in 1901 by Doctor Rose and first described by him in the North American Flora, vol. 22, pt. 27, 1905. "The plant is a succulent, 1½ to 2 feet in height, with large, bright red flowers produced singly or in pairs at the end of the slender branches. It is easily grown and starts readily from cuttings and when planted in mass when in flower it makes a brilliant and striking display." (*Rose.*)

19718. PASSIFLORA EDULIS. **Passion fruit.**

From Australia. Presented by Mr. H. W. Heath, of Chico, Cal.

Plants grown at the Plant Introduction Garden, at Chico, from seed secured by Mr. Heath in Australia. Mr Heath says it is the prevailing edible Passiflora of Australia.

19719. CALOPHYLLUM INOPHYLLUM.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, January 21, 1907.

"*Palo Maria*. A large and exceedingly ornamental tree; flowers fragrant and very showy. The seeds bear 70 to 72 per cent of a heavy, resinous, freely saponifying oil." (*Lyon.*)

19720. CANAVALIA ENSIFORMIS. **Knife bean.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, January 21, 1907.

"*Camcampilan*. A very prolific, climbing bean. The large pods are boiled and eaten when very young and tender." (*Lyon.*)

19721. Pyrus pollveria.

From Christiania, Norway. Presented by Dr. N. Wille, director, Botanic Gardens, through Mr. David Fairchild. Received January 25, 1907.

Cuttings secured for hybridizing experiments.

(See S. P. I. No. 21547 for description.)

19729. Nymphaea ampla.

From Rio Piedras, P. R. Presented by Mr. F. M. Pennock, of the University of Porto Rico, through Mr. O. W. Barrett. Received January 29, 1907.

19733 and 19734. Malus spp.

From Jamaica Plain, Mass. Presented by Prof. C. S. Sargent, of the Arnold Arboretum. Received January 24, 1907.

Seeds, as follows:

19733. Malus sargenti. **19734.** Malus toringo.

Secured for distribution in cooperative hybridizing experiments.

19735 and 19736.

From Kobe, Japan. Received through Mr. John H. Tull, December 15, 1906.

19735. Brassica chinensis. **Rape.**

"(No. 13.) The seed cake is used extensively in Japan and China as a fertilizer for matting grass." (*Tull.*)

19736. Juncus effusus. **Rush.**

"(No. 14.) Old seeds presented by Dr. A. G. Boyer, of Kobe. This is some of the lot he sent several years ago." (*Tull.*) (See S. P. I. No. 9873.)

19737 to 19775. Andropogon sorghum.

From Cedra, Natal. Presented by the Director of Experiment Stations, through Prof. C. V. Piper. Received January 22, 1907.

A collection of sorghums grown at the Central Experiment Farm or thereabouts. Native names received with seeds, which were described on arrival by Mr. C. R. Ball.

19737.

Variety No. 1, Black-hulled white kafir; hulls very dark; head rather long and slender, like Red kafir.

19738.

Same as preceding, with a large percentage of the hulls very light in color.

19739.

Unomputshana. Black-hulled white kafir type, with dark to red colored hulls; slightly longer than the average kafir hulls.

19740.

Utuyana climhlopo. Black-hulled kafir type with head rather longer than the average; hulls reddish to white in color, slightly longer than the average kafir hulls; head 11 inches long.

19741.

Same as the preceding, except that the hulls are lighter and the head more slender; length 10 inches.

19737 to 19775—Continued.

19742.

Variety No. 3, apparently a red × black-hulled kafir cross; head about 13 inches long; grains tinged with red.

19743.

Same as No. 19742, but with grains somewhat redder in color; hulls less dark; length 11 inches.

19744.

Bhampi. Apparently red × black-hulled kafir; seeds rather large, tinged with red; hulls light to dark; head rather club shaped; length 11 inches.

19745.

Variety No. 4; similar to No. 19744, except that the seeds are slightly less red; hulls perhaps a little shorter; length about 11 inches.

19746.

Usutuazana. Black-hulled kafir type; the character of the hulls and seeds indicates a probable cross with orange on red or white kafir; length about 11 inches.

19747.

Gabane. Resembles a cross of orange with either red or black hulled kafir; seeds tinged with red, with red to dark colored hulls; length 11 inches.

19748.

Same as No. 19747, but with more of a kafir-like appearance; seeds rather large, partially inclosed by hulls longer than kafir hulls; head 11 inches long.

19749.

Jara. A good type of red kafir; seeds rather large; length about 13 inches.

19750.

Unkloblonde (long headed). Red kafir type, with light colored hulls: seeds rather large; length 10 inches.

19751.

Same as No. 19750, but with rather large, dark hulls; length 10 inches.

19752.

Ugabana. Red kafir type, with rather large red-colored seeds, partially inclosed with very dark red colored hulls; length about 10 inches.

19753.

Same as No. 19752, but with lighter colored seeds inclosed by dark, shiny hulls; head somewhat club shaped; length about 10 inches.

19754.

Gabana. Red kafir type, with red hulls ranging to light color; seeds reddish; head very slender; length 9 inches.

19755.

Mbedhlana. Red kafir type, with large, dark red colored seeds, partially inclosed by large, dark, shiny hulls; head slender; length 9 inches.

19737 to 19775—Continued.

19756.

Same as No. 19755, differing only in that the hulls are from dark red to reddish in color; head long and very slender; length 9 inches.

19757.

Mbedhlana (white). Similar to No. 19755, but with white-colored seeds; dark to reddish hulls; length 9 inches.

19758.

Uhlangazana. Red kaffir type, with reddish colored seeds, partially inclosed by rather larger, reddish to dark colored hulls; head 10 inches long and very slender.

19759.

Same as No. 19758, but with dark, shiny hulls; head somewhat shorter and broader; length 9 inches.

19760.

Uhlangazana (white). Similar to No. 19758, but with lighter colored seeds, partially inclosed by reddish to brown colored hulls; length of head 10 inches.

19761.

Same as No. 19760, but with much darker colored hulls; head slightly shorter and broader; length 9 inches.

19762.

Umchlocnkuku (fowl's eye). White kafir type of head, with large seeds tinged with red and partially inclosed by large, dark, shiny hulls; length 9 inches.

19763.

Hlakuva (so called because thought to look like castor-oil seeds). A very small headed, short variety. Smoky brown colored seeds, with dark colored, shiny hulls; head rather small, slender; length 8 inches.

19764.

Variety No. 2; white durra, India type, with very white seeds and light straw colored hulls; head rather broad; length 8 inches.

19765.

Variety No. 5; a loose, open-headed type, very heavily seeded; seeds light colored, slightly tinged with red; hulls light straw colored; head about 10 inches long.

19766.

Unukana. A large, open-headed type, with medium small, reddish seeds, inclosed partially by rather large, dark straw colored hulls; seems related to some of the red types of Indias; head about 12 inches long.

19767.

Itiva. A Collier type of head, with Collier seeds; long, light to darker colored hulls, showing not a trace of white margin; head lightly seeded.

19768.

Undendebula. Similar to No. 19767, but more heavily seeded and showing a trace of margin on the dark colored hulls.

19769.

Igenga Igenga ntombi. A Collier type, but with lighter colored seeds, two-thirds inclosed by black, shiny hulls; head rather heavily seeded.

19737 to 19775—Continued.

19770.

Itshobalehansi (goose-tail). A very long branched, drooping type of head, with light colored seeds nearly inclosed by dark to light colored hulls; head fairly well seeded.

19771.

Umgungobotive. Long-branched, drooping head; a Collier type, with Collier seeds; head lightly seeded.

19772.

Uoigabela. A close type of head, with small, brown-colored seeds, nearly inclosed by dark colored hulls; rachis extending through the head; length 8 inches.

19773.

Ibodhla. A rather close amber type of head, with small, light colored seeds and dark hulls; head fairly well seeded.

19774.

Ihlosa (the higher). Minnesota amber type with long-pointed, smooth, black glumes; head fairly well seeded; length about 9 inches.

19775.

Umnyamana (dark). A small, semicompact head with seeds no larger than sumac seeds and nearly inclosed by dark, shiny hulls; rachis extending through the head; head well filled; length 9 inches.

19776. ALLIUM FISTULOSUM.

From Waseda, Tokyo, Japan. Presented by J. Ikeda & Co., February 19, 1906.

Shimonita. "This is quite a distinct vegetable, intermediate in character between the leek and onion. On first sight the stem would unhesitatingly be pronounced Musselburgh leek, and it could be sold as such, but it is readily distinguished by its round hollow leaf. The central leaf forms a very peculiarly pointed cylinder, which is solid and of good flavor, but rather peppery." (*Tracy.*)

19778. XANTHOSOMA sp. **Yautia.**

From Tuxtla Gutierrez, Chiapas, Mexico. Presented by Don Pompilio Moguel, through Mr. G. N. Collins. Received January 31, 1907.

"Roots of a variety locally known as *Tekixcamote.*" (*Collins.*)

19779 to 19784. HORDEUM spp. **Barley.**

From Svalöf, Sweden. Received through the General Swedish Seed Company February 1, 1907.

A collection of pedigreed brewing barleys, as follows:

19779. HORDEUM DISTICHUM ERECTUM.

Primus.

19780. HORDEUM DISTICHUM NUTANS.

Prinsess.

19781. HORDEUM DISTICHUM NUTANS.

Chevalier II.

19782. HORDEUM DISTICHUM ERECTUM.

Svanhals.

19779 to 19784—Continued.

19783. HORDEUM VULGARE.

Gutekorn.

19784. HORDEUM VULGARE.

Sexradigt.

19789. VANGUERIA INFAUSTA. **Wild medlar.**

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, botanist, Transvaal Department of Agriculture. Received February 4, 1907.

"Seed of an edible fruit with flavor of a medlar. Grows mostly in frostless parts of the Transvaal on stony hillsides." (*Davy.*)

19790 to 19792. KENNEDYA spp.

From Sydney, New South Wales. Presented by Hon. Walter S. Campbell, director, Department of Agriculture. Received January 19, 1907.

19790. KENNEDYA MONOPHYLLA.

19791. KENNEDYA PROSTRATA.

19792. KENNEDYA RUBICUNDA.

19795 and 19796.

From Reykjavik, Iceland. Presented by Prof. Thorhallur Bjarnarson, president, Icelandic Agricultural Society. Received February 2, 1907.

Seeds for introduction into Alaska.

19795. BRASSICA RAPA. **Turnip.**

"The turnip is cultivated in Iceland a good deal for human food, and it is about the only plant which produces seed there. This seed, originally from Norway, is of a good sort and has been cultivated for about twenty years in Iceland." (*Bjarnarson.*)

19796. FESTUCA RUBRA. **Red fescue.**

19797. XANTHOSOMA sp. **Yautia.**

From Ancon, Canal Zone, Panama. Received through Mr. Henry F. Schultz February 9, 1907.

Mr. Schultz calls this species *X. atrovirens.*

19798. MUSA SAPIENTUM. **Banana.**

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, February 11, 1907.

Bungulan.

19799. CHAETOCHLOA SULCATA.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, botanist, Transvaal department of agriculture. Received February 6, 1907.

"A most useful pasture and hay grass for partially shaded woodland. It is sensitive to frost. It is variously called *Natal Buffel* and *Bush Buffel* grass. It is also an ornamental grass worth cultivating in gardens in forestless regions." (*Davy.*)

19800. Trifolium repens. **White clover.**

From Milan, Italy. Received from Mr. Fratelli Ingegnoli, through Mr. Edgar Brown, February 7, 1907.

Lodino.

19806. Oroxylon indicum.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, February 11, 1907.

"Seed of a medium to large tree, the timber of which is in special demand for the manufacture of matches." (*Lyon.*)

19807. Dioscorea sativa. **Yam.**

From Mayaguez, Porto Rico. Received through the Porto Rico Agricultural Experiment Station, February 12, 1907.

"*Guinea.* The cylindrical shape, the medium thick skin, the tendency to produce only one or two large roots to the hill, and its resistance to drought render the variety the favorite among the natives of Porto Rico." (*Barrett.*)

19810 to 19821. Ipomoea batatas. **Sweet potato.**

From Santiago de las Vegas, Cuba. Presented by Prof. C. F. Austin, chief, Department of Horticulture, Estacion Central Agronomica, through Mr. O. W. Barrett. Received February 15, 1907.

A collection of Cuban varieties collected by the Estacion Central Agronomica. The numbers in parentheses are those under which they were received.

19810.

Barbacoa. (No. 6076.)

19811.

Morado. (No. 6079.)

19812.

Yema de huevo. (No. 6082.)

19813.

No. 10. (No. 6085.)

19814.

Mulato. (No. 6077.)

19815.

Cinco dedos. (No. 6080.)

19816.

Papa. (No. 6083.)

19817.

Cuban. (No. 5221.)

19818.

Matojo. (No. 6078.)

19819.

No. 6. (No. 6081.)

19820.

No. 9. (No. 6084.)

19821.

Mono Negro. (No. 5369.)

19822 and 19823.

From Marsovan, Turkey. Presented by Mr. H. Caramanian, Monastery Farm, through Prof. C. V. Piper. Received February 18, 1907.

19822. Medicago sativa. **Alfalfa.**

19823. Vicia sativa. **Common vetch.**

19824 to 19827.

From Sapporo, Japan. Presented by Prof. K. Oshima, director, Hokkaido Agricultural Experiment Station. Received February 18, 1907.

19824. Lotus corniculatus japonicus. **Yellow trefoil.**

19825. Polygonum sachalinense.

19826. Brachypodium japonicum. **Japanese wheat-grass.**

19827. Miscanthus sinensis. **Eulalia.**

19836 to 19841. Ipomoea batatas. Sweet potato.

From Sibpur, India. Presented by Prof. A. T. Gage, superintendent, Royal Botanic Gardens. Received February 20, 1907.

19836.

Japan Brown Selected.

19837.

Dhamakia White.

19838.

Theganía Red Selected.

19839.

Poona Local.

19840.

Theganía White Selected.

19841.

Cawnpore White Selected.

19842 and 19843.

From Parras, Coahuila, Mexico. Received through Mr. W. E. Safford, February 20, 1907.

19842. Amygdalus persica. **Peach.**

"Fruit of fine quality, yellow, freestone; drought resisting; from altitude of 5,000 feet above sea level. Comes true to seed." (*Safford.*)

Trees.

19843. Cydonia vulgaris. **Quince.**

"Fruit of fine quality; drought resisting; from altitude of 5,000 feet above sea level." (*Safford.*)

Trees.

19853 to 19857.

From Funchal, Madeira. Received through Mr. David Fairchild, February 23, 1907.

A collection of cuttings, as follows:

19853. Anona cherimolia. **Cherimoyer.**

"(No. 01, Jan. 31, 1907.) This fruit tree thrives in all the quintas of Funchal, and there are probably different varieties of it, though no distinctive names are given to the various sorts. Two forms were pointed out to me by the gardener of Mr. Reid's quinta, a long-fruited form and a heart-shaped one. These scions are from the long-fruited form. The fruits vary greatly in size, but the one I saw of this sort was 5 inches long. Seeds vary in number.

"There is a great variation in the character of the prominence of the stigmatic protuberances, or 'spines.' This variety has few such and is comparatively smooth. The natives say the 'spiny' forms have many seeds, the spineless have few. No seedless form has been encountered. This sort is considered of good flavor, but not equal to the heart-shaped form." (*Fairchild.*)

19854. Anona cherimolia. **Cherimoyer.**

"(No. 02.) Scions of the heart-shaped form of cherimoyer from Mr. Reid's quinta. The fruit of this (i. e., the single good one I saw) is about 4½ inches wide and 4½ inches from stem to tip. Mr. Reid's gardener declares this has a superior flavor to the long form and has fewer seeds. Mr. Blandy believes that abundant use of manure about the trees makes them produce fruit with few seeds." (*Fairchild.*)

19855. Anona cherimolia. **Cherimoyer.**

"(No. 04, Feb. 2, 1907.) Scions from trees in the quinta of Mr. J. B. Blandy. A variety which Mr. Blandy assures me is of unusually good quality, with few seeds compared with the ordinary fruit of the island. Mr. Blandy grows his trees on a high trellis, so that the fruits hang in the shade. They are all grafted on seedlings about 3 feet above the ground." (*Fairchild.*)

19853 to 19857—Continued.

19856. SALIX VIMINALIS. **Osier willow.**

"(No. 03, Feb. 2, 1903.) One of the principal plant industries of Madeira is the manufacture of baskets and chairs from the native willow, or osier. This willow is grown in the mountains and pollarded to make it produce long, branchless shoots. There seem to be no large areas covered with the trees, but many small areas all over the mountain sides. The baskets, chairs, etc., made from it are remarkable for their lightness and durability." (*Fairchild.*)

19857. SALIX BABYLONICA. **Weeping willow.**

"(No. 05, Feb. 2, 1907.) The parent of this willow came as a cutting from a tree growing in St. Helena over the grave of Napoleon I. This is the second generation, and is growing in quinta St. Luzia, belonging to J. B. Blandy, esq." (*Fairchild.*)

19858. BLIGHIA SAPIDA. **Akee.**

From Ancon, Canal Zone, Panama. Received through Mr. Henry F. Schultz, February 25, 1907.

19862. SECHIUM EDULE. **Chayote.**

From Parras, Coahuila, Mexico. Received through Mr. W. E. Safford, of the Bureau of Plant Industry, February 21, 1907.

"Fruits of a chayote, said to be of fine quality; drought resisting; from altitude of 5,000 feet above sea level, where there are occasional frosts." (*Safford.*)

19863. PISUM ARVENSE. **Field pea.**

From Guelph, Ontario, Canada. Received through the Ontario Agricultural College, February 23, 1907.

Early Britain.

19885 to 19895.

From Osaka, Japan. Presented by Prof. K. Okada, director of Kinai Branch Station, Kashiwara Kawachi. Received February 12, 1907.

19885 to 19887. GOSSYPIUM sp. **Cotton.**

19885.

Akaki. A red-stalked variety.

19886.

Aoki. A green-stalked variety.

19887.

Chia wata.

19888 to 19891. ORYZA SATIVA. **Rice.**

19888.

Bungo.

19889.

Shin Shiu Kaneko.

19890.

Shijunichi Washe.

19891.

Yamata Jikara.

"These rices are all early-maturing varieties." (*Okada.*)

19892 to 19895. HORDEUM VULGARE. **Barley.**

A collection of naked barleys.

19892.

Kamamugi.

19893.

Tanbashiro.

19894.

Wakamatsu.

19895.

Yone Hadaka.

19897 to 19905.

From Funchal, Madeira. Received through Mr. David Fairchild, March 4, 1907.

19897. DOMBEYA SPECTABILIS (?).

"(No. 014, Feb. 16, 1907.) Cuttings of a most beautiful ornamental tree with pendent flower clusters of pink flowers. These clusters are as large as those of a Viburnum and more delicate. The large-leaved, rapidly growing tree is an ornamental of value aside from its flowers. Known in Portugal as a stove plant, but here is grown in the quintas everywhere. Propagates easily from cuttings." (*Fairchild.*)

19898. ANONA CHERIMOLIA (?). **Cherimoyer.**

"(No. 015, Feb. 15, 1907.) Grafting wood of a tree in the quinta of Mr. C. L. Power, of Funchal. I am assured by him that it bears fruit of excellent quality, heart shaped in form, and with comparatively few seeds. It is not known by any varietal name, though it is a grafted tree. Presented by Mr. Power, who will send more if wanted." (*Fairchild.*)

19900. PHYSALIS PERUVIANA. **Cape gooseberry.**

"(No. 016, Feb. 17, 1907.) Fruit grown in the mountains of this island for the production of jam. This jam is one of the most delicious things of the kind I have ever tasted. It is made by boiling 1 pound of sugar to 1 pound of berries, first boiling sugar in 1 cup of water until quite dissolved. Boil for one hour, stirring all the time." (*Fairchild.*)

19901. ANONA CHERIMOLIA (?). **Cherimoyer.**

"(No. 07, Feb. 12, 1907.) Seed from good fruit served on the hotel table here. For the breeders of Anona. The fruits here are extremely variable. Many are grafted, but there are no recognized varieties." (*Fairchild.*)

19902. JUNCUS sp. **Rush.**

"(No. 08, Feb. 12, 1907.) From the village of Llogar do Baishe (Ponto do Sol). Specimen and seeds of a species of Juncus said to have been used in the manufacture of rush mattings. The stems are not over 27 inches long and the plant, I judge, grows to a good old age. Along margins of wet places near seashore probably saline. Now in bloom. For more information write to Mr. A. G. Jardine, of Funchal." (*Fairchild.*)

19903. CAPSICUM ANNUUM. **Red pepper.**

"(No. 012.) Two interesting red peppers from the market of Funchal. I can not find that any red pepper is made from them but they are eaten cooked." (*Fairchild.*)

19904. ANONA CHERIMOLIA. **Cherimoyer.**

"Seed of an anona from Mr. Reid's villa. Long variety; acid flavor." (*Fairchild.*)

(No number assigned by Mr. Fairchild, but no doubt these seeds came from a fruit from same stock as S. P. I. No. 19853.)

19905. ANONA CHERIMOLIA. **Cherimoyer.**

"Heart-shaped form; very sweet; from Mr. Reid's quinta, Funchal." (*Fairchild.*) Seed.

(Probably from the same tree as cuttings S. P. I. No. 19854.)

19909. CITRUS LIMONUM. **Lemon.**

From San Juan, Porto Rico. Presented by Mr. A. B. Mitchell, through Mr. O. W. Barrett. Received March 4, 1907.

Rough. Seed.

19910. Paspalum dilatatum. **Large water-grass.**

From Coff's Harbor, New South Wales. Received through Mr. W. Seccombe, March 4, 1907.

19911. Trifolium pratense. **Red clover.**

From Kuhlewyl, Switzerland. Received through Mr. H. R. Pulfer, March 2, 1907.

Perennial.

19912. Sesbania macrocarpa.

From Yuma, Ariz. Received through Mr. E. L. Crane, March 2, 1907.

"This plant grows to a height of 15 feet or more and covers hundreds, perhaps thousands, of acres of the rich alluvial soil along the banks of the Colorado River, south of Yuma. It is perhaps one of the largest annual leguminous plants in America and is remarkable as covering completely such large areas of land. The roots are loaded with nodules and it is probable that this plant has for hundreds of years added materially to the fertility of the delta region of the Colorado River. The attention of Prof. R. H. Forbes, of the Arizona Agricultural Experiment Station, at Tucson, Ariz., and the attention of the writer were attracted at about the same time to the possibility of this plant being a valuable species for increasing the nitrogen content of soils in the Southwest. Seeds were collected for the purpose of making this test, and the preliminary trials have shown it to have considerable value for this purpose. It should be sown in late spring, as it requires a great deal of warmth for germination." (*Fairchild.*) (See Bulletin 1903, Arizona Agricultural Experiment Station.)

19924 to 19931.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, botanist, Transvaal Department of Agriculture. Received March 4, 1907.

Descriptive notes furnished by Obe resident magistrate, Potgietersrust, Obe neighborhood, from which Obe samples were obtained. Numbers in parentheses are those assigned by Professor Davy.

19924 to 19930. Andropogon sorghum. **Kafir corn.**

19924.

Phikhulo. A good, strong variety; prolific. (No. 3016/06–7.)

19925.

Mothlokathlong, meaning "without shame"; so called on account of its rapid growth. Requires lots of room between plants. (No. 3017/06–7.)

19926.

Mogathla ou Kubu. Not a favorite. (No. 3020/06–7.)

19927.

Segope. Long, thin stalks; requires protection from wind. (No. 3018/06–7.)

19928.

Phale. Makes excellent meal and beer; long stalks, and requires to be protected from wind. (No. 3013/06–7.)

19929.

Mosadi Teighufa, meaning "jealous woman." Vigorous and prolific; a great favorite with the natives for beer making. (No. 3014/06–7.)

19930.

Mothlerane. Strong growth and short stalks. (No. 3015/06–7.)

19924 to 19931—Continued.

19931. PENNISETUM SPICATUM. **Pearl millet.**

A kind of hemp not unlike the head of a bulrush when in bearing: very rapid growth and good drought resister. Used by the Maxalanga a great deal.

19942 to 19950. IPOMOEA BATATAS. **Sweet potato.**

From Port of Spain, Trinidad, British West Indies. Presented by Dr. E. André, through Mr. O. W. Barrett. Received March 7, 1907.

Sweet potatoes from Barbados, with notes by Doctor André.

19942.

White Nut. A very dry potato; takes five months to mature.

19943.

Bourbon. Very mellow; will keep in land nine months.

19944.

White Sealy. An early potato; bears well.

19945.

Huffs. A good potato; keeps well and is an excellent shipping variety.

19946.

Minnie Wits. An early potato; bears well.

19947.

Stafford. A nice edible potato; red skin.

19948.

Hen and Chickens. A very prolific variety.

19949.

Fire Brass (red). A very prolific variety; does not cook well.

19950.

Caroline Sea.

19952 and 19953. COLOCASIA spp. **Taro.**

From Hilo, Hawaii. Presented by Mr. L. C. Lyman, principal, Hilo Boarding School, March 7, 1907.

19952.

Lehua.

19953.

Kuoho.

"Two of the best varieties of upland taro, named by the natives as above. The first named, the royal taro of the old Hawaiian kings, is of a pink color when cooked, and matures in about eight months.

"The other variety is most commonly raised; is white when cooked, and requires about a year to mature." (*Lyman.*)

19954 to 19956.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College. Received October 26, 1906.

19954. PIPTADENIA COMMUNIS.

19955. CINCHONA CABABAYENSIS.

19956. TECOMA CHRYSANTHA.

Ipe 'Amarello.

19957. ROSA HUGONIS.

From Paris, France. Received from Vilmorin-Andrieux & Co., March 11, 1907.

Cuttings.

19958. CHLORIS GAYANA. **Rhodes-grass.**

From Auckland, New Zealand. Received through E. C. Pilkington & Co., March 12, 1907.

19959. CHLORIS GAYANA. **Rhodes-grass.**

From Sydney, New South Wales. Received through Anderson & Co., March 12, 1907.

19960 to 19967.

From Aburi, Gold Coast. Presented by Prof. A. E. Evans, Acting Director of Agriculture, through Mr. O. W. Barrett. Received March 16, 1907.

19960. EUPHORBIA sp.

19961. KIGELIA AFRICANA.

19962. GARCINIA HANBURYI.

19963. CARDIOSPERMUM BARBICAULE.

19964. SIDEROXYLON DULCIFICUM.

19965. MONODORA MYRISTICA.

19966. TELFAIRIA OCCIDENTALIS.

19967. BUTYROSPERMUM PARKII.

19970. TRIFOLIUM PRATENSE. **Red clover.**

From Chile. Presented by the Courteen Seed Company, Milwaukee, Wis., through Prof. C. V. Piper. Received March 2, 1907.

Chilean.

19972 to 19977. MEDICAGO SATIVA. **Alfalfa.**

From Rocky Ford, Colo. Received through Mr. P. K. Blinn, March 15, 1907.

Seed from individual plants selected by Mr. Blinn.

19972.

Turkestan. Yield, 66 grams. Fine stems; thick leaf system, but seeds ripened very irregularly; lot of green heads. (No. 1.)

19973.

Turkestan. Yield, 40 grams. Very uniform in ripening seed; no aftergrowth. (No. 9.)

19974.

Turkestan. Yield, 30 grams. No rust; seed uniformly ripe. (No. 11.)

19975.

Turkestan. Yield, 54 grams. Large heads; uniform set of seed; fairly uniform in ripening. (No. 12.)

19976.

Turkestan. Yield, 55 grams. Stems fine; leaves well retained; no rust; seed ripened up well, while stem and leaves remained green. (No. 16.)

19977.

Native. Plant found on railroad right of way under perfect "dry-farming conditions"; no irrigation within 75 to 100 feet; soil water at level 16 feet deep; sand-clay loam; yield of this plant, 49 grams; other plants near it failed entirely to seed; this plant had a fine large flower and head of rather light blue color.

19978. Psidium sp. **Guayabilla.**

From Colombia. Presented by Mr. Alfonso Delgada, Colombian consul, New Orleans, La., through Mr. O. W. Barrett. Received March 14, 1907.

"Seed of a guayabilla said to be native to the mountains of central Colombia and to resemble guava in many points." (*Delgada.*)

19979. Mucuna lyoni.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, February 13, 1907.

"This species was grown in a number of places in the South in comparison with the ordinary velvet bean, and our belief, based on one season's work, is that lyoni is a distinct advance over utilis. It is especially characterized by its more rapid growth and much greater prolificness, which ought to make it possible to grow seed considerably cheaper than the seed of the Florida velvet bean." (*C. V. Piper.*)

19980 to 19993.

From Yokohama, Japan. Received through L. Boehmer & Co., March 19, 1907.

19980. Phaseolus vulgaris. **Bean.**

Received under the name of "*Fuiri Mame*, speckled soja bean."

19981. Glycine hispida. **Soy bean.**

Received under the name of "*Shiro Mame*, the white soja bean."

19982. Glycine hispida. **Soy bean.**

Received under the name of "*Kuro Mame*, the black soja bean."

19983. Glycine hispida. **Soy bean.**

Received under the name of "*Daizu* or *O-mane*, *Dolichos soja*."

19984. Glycine hispida. **Soy bean.**

Received under the name of "*Wase* or *Natsu Mame*, early summer bean."

19985. Glycine hispida. **Soy bean.**

Received under the name of "*Nagate Mame*, middle late bean."

19986. Glycine hispida. **Soy bean.**

Received under the name of "*Okute Mame*, late bean."

19987. Glycine hispida. **Soy bean.**

Received under the name of "*Kuro-Teppo Mame*, round, middle-late bean."

19988. Phaseolus angularis. **Adzuki bean.**

Received under the name of "*Oku Adzuki*, late *P. typicus*."

19989. Phaseolus angularis. **Adzuki bean.**

Received under the name of "*Azuki*, *P. radiatus*."

19990. Canavalia ensiformis. **Knife bean.**

Received under the name of "*Nata Mame*, white sword bean; *Dolichos incurvus*."

19991. Canavalia ensiformis. **Knife bean.**

Received under the name of "*Akai Nata Mame*, red sword bean; *Dolichos incurvus*."

19992. Puerabia thunbergiana. **Kudzu vine.**

19993. Lespedeza cyrtobotrya.

19994 to 19995.

From Yokohama, Japan. Received through the Yokohama Nursery Company, March 14, 1907.

Plants imported for use in matting-plant experiments.

19994. CYPERUS TEGETIFORMIS. **Matting sedge.**

19995. JUNCUS EFFUSUS. **Matting rush.**

19996. COLOCASIA ANTIQUORUM ESCULENTA. **Taro.**

From Funchal, Madeira. Received through Mr. David Fairchild, March 19, 1907.

"(No. 017, Feb. 22, 1907.) Sets of the so-called *Igname* of Madeira. Probably, but not certainly, the white, or *Branca*, variety. According to one of the green grocers here, John de Pontes, Rua dos Tanoeiros 40–42, these *Ignames* sell for 3 cents to 4 cents a pound, while sweet potatoes sell for only 2 cents. Crop comes in in February and ends in April. Keep well; yield about one-third that of sweet potatoes; plantations continually watered; planting at all times of the year; side rootstocks or tubers removed and the central stock left to form a perpetual plantation. The growers in the country boil the tubers before bringing them to market. Then they are brought down from the hills in great baskets and sold in this boiled condition for 5 pence (10 cents) a pound. They are very palatable and nourishing, I believe, and rank here as more of a delicacy than the sweet potato. Only two kinds are known here so far as I have ascertained." (*Fairchild.*)

19997. COLOCASIA ANTIQUORUM ESCULENTA. **Taro.**

From Funchal, Madeira. Received through Mr. David Fairchild, March 19, 1907.

"(No. 018, Feb. 22, 1907.) Sets of the so-called *Vermeilho*, or red variety. There seems to be little preference given to either of these sorts (this one and S. P. I. No. 19996). These are just now coming into market as a crop. They are peeled or scraped, then boiled three to four hours in salt water." (*Fairchild.*)

19998. JUNCUS sp. **Rush.**

From Caldas da Rainha, Portugal. Received through Mr. David Fairchild, March 19, 1907.

"(No. 018a, Feb. 28, 1907.) Roots and seeds of a very slender rush growing in very sandy soil near the waterways of this place. It is used for tying vines to their supports all over this part of Portugal and is sold in the market place. I measured some of the stems and found them 5½ feet long. They are unusually tough and slender. Mats are made from them also." (*Fairchild.*)

19999. JUNCUS sp. **Rush.**

From Maorga, near Alcobasso, Portugal. Received through Mr. David Fairchild, March 19, 1907.

"(No. 019, Feb. 28, 1907.) Roots of a species of Juncus similar to, if not identical with, No. 018a, S. P. I. No. 19998, but from a field of Juncus which is cut over every year. The soil is a light, sandy one, just like that on Cat Island, S. C.; in fact, turpentine pines are growing all over the land. The rush grows in swampy places which are dry during a period of the year. Cutting is done in May. Used for matting and for tying vines." (*Fairchild.*)

20001 to 20229.

From Manchuria, northern Korea, and eastern Siberia. Received through Mr. Frank N. Meyer, agricultural explorer, February 20, 1907.

20001 to 20229—Continued.

A collection of seeds, as follows:

20001. PHASEOLUS VULGARIS. **Bean.**

From Tok-sil-tong, northern Korea. "(No. 309a, Aug. 12, 1906. A dwarf bean growing at an altitude from 2,000 to 4,000 feet above sea level. This is a very prolific variety and apparently requires far less heat than other varieties. Used boiled when either green or dry with rice, oats, barley, and millet." (*Meyer.*)

20002. PHASEOLUS VULGARIS. **Bean.**

From Tok-sil-tong, northern Korea. "(No. 315a, Aug. 12, 1906.) A very nutritious climbing bean of which the seeds are used either green or dry in boiled rice, millet, oats, or barley." (*Meyer.*)

20003. PHASEOLUS VULGARIS. **Bean.**

From Liaoyang, Manchuria. (No. 316a, June 8, 1906.)

20004. PHASEOLUS VULGARIS. **Bean.**

From Tok-sil-tong, northern Korea. "(No. 317a, Aug. 12, 1906.) A very long, climbing, string bean; used as a vegetable when fresh." (*Meyer.*)

20005. VIGNA SESQUIPEDALIS.

From Antung, Manchuria. "(No. 310a, July 12, 1906.) A climbing string bean used as a summer vegetable when green; when dry is eaten boiled with rice." (*Meyer.*)

20006. VIGNA UNGUICULATA. **Cowpea.**

From Antung, Manchuria. "(No. 311a, July 12, 1906.) A few black seeds found in No. 310a (S. P. I. No. 20005), and as such the same description applies to them." (*Meyer.*)

20007. PHASEOLUS ANGULARIS. **Adzuki bean.**

From Shi-wa-nanan, northern Korea. "(No. 308a, July 20, 1906.) A variety of small beans growing at high altitudes on very poor soils. Are used as food, being boiled with rice and millet." (*Meyer.*)

20008. PHASEOLUS ANGULARIS. **Adzuki bean.**

From near Musan, northern Korea. "(No. 312a, Sept. 1, 1906). A dwarf bean growing at high altitudes. These beans are never eaten when fresh; when dry they are boiled with rice and millet." (*Meyer.*)

20009. PHASEOLUS ANGULARIS. **Adzuki bean.**

From near Musan, northern Korea. "(No. 313a, Sept. 1, 1906.) Probably a whitish variety of No. 312a (S. P. I. No. 20008). This variety is little seen here." (*Meyer.*)

20010. PHASEOLUS ANGULARIS. **Adzuki bean.**

From Shi-wa-nanan, northern Korea. "(No. 314a, July 20, 1906.) A few seeds found in No. 308a (S. P. I. No. 20007); apparently a different variety." (*Meyer.*)

20011. GLYCINE HISPIDA. **Soy bean.**

From Ko-bau, northern Korea. "(No. 318a, Aug. 12, 1906.) A green variety of soy bean growing at high elevations. This variety is eaten as a food and is mostly grown in broad strips between buckwheat; a very late ripener. Seems to be the most northerly variety of soy bean seen yet and will do well in cool climes." (*Meyer.*)

20012. PHASEOLUS ACONITIFOLIUS.

From Musan, northern Korea. (No. 319a, Aug. 29, 1906.)

20001 to 20229—Continued.

20013. VICIA sp. **Vetch.**

From near Tok-sil-tong, northern Korea. "(No. 320a, Aug. 12, 1906.) A vetch found growing in rocky, dry soils, sometimes covering a large expanse; may be a fodder plant." (*Meyer.*)

20014. VICIA sp. **Vetch.**

From northern Korea. "(No. 321a, Sept. 6, 1906.) A broad-leaved vetch growing in hedges and making a growth of more than 10 feet. May be a fodder plant. Grow it on trellises." (*Meyer.*)

20015. VICIA sp. **Vetch.**

From the mountains of northern Korea. "(No. 322a, Aug. 21, 1906.) A vetch with many flowers of a purplish blue color found growing along ditches. Attains a height of from 4 to 5 feet. May be a fodder plant." (*Meyer.*)

20016. VICIA sp. **Vetch.**

From the mountains of northern Korea. "(No. 323a, Aug. 20, 1906.) A vetch found growing between shrubbery on peaty soil; makes big masses of foliage. May be a fodder plant." (*Meyer.*)

20017. VICIA sp. **Vetch.**

From northern Korea. "(No. 324a, Sept. 6, 1906.) A narrow-leaved vetch growing 8 to 10 feet tall; found in hedges. May be a fodder plant. Grow it on trellises." (*Meyer.*)

20018. VICIA sp. **Vetch.**

From northern Korea. "(No. 325a, Aug. 27, 1906.) A variety having few flowers, but many stems. May be a fodder plant." (*Meyer.*)

20019. VICIA sp. **Vetch.**

From Lun-shi-dong, northern Korea. (No. 326a, Aug. 27, 1906.)

20020. LATHYRUS sp.

From northern Korea. (No. 327a, Aug. 20, 1906.)

20021. TRIFOLIUM sp. **Clover.**

From northern Korea. "(No. 328a, Aug. 15, 1906.) A perennial clover found growing in rocky, strong soil. May be of use as a forage plant in dry, sterile regions." (*Meyer.*)

20022. TRIFOLIUM sp. **Clover.**

From the mountains of northern Korea. "(No. 329a, Sept. 5, 1906.) A perennial clover found growing in sandy soil along a creek. For description see No. 328a (S. P. I. No. 20021)." (*Meyer.*)

20023. MEDICAGO sp. **Alfalfa.**

From near Hoi-ryong, northern Korea. "(No. 330a, Sept. 5, 1906.) A small-leaved alfalfa of crawling habit; only one plant on a sandy waste. May be a very valuable forage and pasturing plant." (*Meyer.*)

20024. ASTRAGALUS sp.

From northern Korea. "(No. 331a, Sept. 6, 1906.) An annual growing in rocky river beds and on sandy wastes. See if it is a fodder plant for desert regions." (*Meyer.*)

20025. ERODIUM sp.

From near Musan, northern Korea. "(No. 332a, Sept. 1, 1906.) A species which grows on very sandy soils and may be of use as a fodder plant like the Erodiums in California." (*Meyer.*)

20001 to 20229—Continued.

20026. SPINACIA OLERACEA. **Spinach.**

From Liaoyang, Manchuria. "(No. 267a, June 20, 1906.) A good, large-leaved spinach grown in sheltered places all through the winter and producing greens until early summer." (*Meyer.*)

20027. SPINACIA OLERACEA. **Spinach.**

From Antung, Manchuria. "(No. 268a, July 12, 1906.) A large-leaved spinach grown in sheltered places during the whole winter and producing greens until early summer." (*Meyer.*)

20028. RAPHANUS SATIVUS. **Radish.**

From Liaoyang, Manchuria. "(No. 269a, June 20, 1906.) A long, white, winter variety. Chinese name *Pai-loba.* The seeds are sown in the summer and the radishes are harvested before the frost sets in and are kept in rat-proof cellars." (*Meyer.*)

20029. RAPHANUS SATIVUS. **Radish.**

From Liaoyang, Manchuria. "(No. 270a, June 20, 1906.) A long, white, summer variety. A rather good variety, of which the seeds are sown very early in the spring on somewhat sheltered places and which produces good roots in about ten weeks." (*Meyer.*)

20030. RAPHANUS SATIVUS. **Radish.**

From Liaoyang, Manchuria. "(No. 271a, June 20, 1906.) A long, red, summer variety; eaten either boiled or stewed. A very good vegetable, which is even served in the foreign hotels in northern China. Sow early on well-prepared soil in sheltered places." (*Meyer.*)

20031. RAPHANUS SATIVUS. **Radish.**

From Shan-hai-kwan, China. "(No. 272a, Apr. 28, 1906.) A white winter radish. Chinese name *Pa loba.*" (*Meyer.*)

20032. RAPHANUS SATIVUS. **Radish.**

From Shan-hai-kwan, China. "(No. 273a, Apr. 28, 1906.) A red winter radish. Chinese name *Hong loba.* Said to be a large variety. Plant 1 foot apart in each direction in porous soil." (*Meyer.*)

20033. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Liaoyang, Manchuria. "(No. 274a, June 20, 1906.) A summer cabbage; Chinese name *Pai tsay.* A loose-headed form of the Chinese cabbage. This variety is sown early in the spring and eaten all through the summer." (*Meyer.*)

20034. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Liaoyang, Manchuria. "(No. 275a, June 20, 1906.) For description see No. 274a (S. P. I. No. 20033); but this is said to be a somewhat inferior variety." (*Meyer.*)

20035. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Liaoyang, Manchuria. "(No. 276a, June 20, 1906.) Chinese name *Pai tsay.* A variety of cabbage which is used for salt pickling and is also dried in the sun. The pickled cabbage is considered a necessary relish at a Chinese meal." (*Meyer.*)

20036. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Liaoyang, Manchuria. "(No. 277a, June 7, 1906.) A superior variety of summer cabbage. Chinese name *Pai tsay.*" (*Meyer.*)

20001 to 20229—Continued.

20037. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Antung, Manchuria. "(No. 278a, June 12, 1906.) A variety of the Chinese summer cabbage, said to grow very large on moist, rich soils; does not stand great drought or heat. Can be bleached by tying the leaves together." (*Meyer.*)

20038. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Antung, Manchuria. "(No. 279a, July 12, 1906.) Chinese name *Pai tsay*. These seeds came from a different grower, but in all probability are the same as No. 278a (S. P. I. No. 20037)." (*Meyer.*)

20039. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Shan-hai-kwan, China: "(No. 280a, Apr. 28, 1906.) Chinese name *Pai tsay*. A good winter cabbage, said to grow on dry ground." (*Meyer.*)

20040. CUCUMIS MELO. **Muskmelon.**

From Antung, Manchuria. "(No. 290a, July 10, 1906.) A small, green melon. These fruits are eaten like apples by the Chinese and Koreans and are not bad. They may be of use to us as preserves or, when somewhat improved, as a table fruit. Require apparently less heat to ripen than ordinary muskmelons do." (*Meyer.*)

20041. CUCUMIS MELO. **Muskmelon.**

From Antung, Manchuria. "(No. 291a, July 10, 1906.) A small, white melon. For description see No. 290a (S. P. I. No. 20040)." (*Meyer.*)

20042. CUCUMIS MELO. **Muskmelon.**

From Tcho-san, northern Korea. "(No. 292a, Aug. 4, 1906.) A small, green melon. For description see No. 290a (S. P. I. No. 20040)." (*Meyer.*)

20043. CUCUMIS MELO. **Muskmelon.**

From Pyok-tong, northern Korea. "(No. 293a, July 24, 1906.) A small, green melon. For description see No. 290a (S. P. I. No. 20040)." (*Meyer.*)

20044. CUCUMIS MELO. **Muskmelon.**

From Kang-ko, northern Korea. "(No. 294a, Aug. 8, 1906.) A somewhat larger variety than No. 290a (S. P. I. No. 20040); otherwise the same description applies to it." (*Meyer.*)

20045. CUCUMIS MELO. **Muskmelon.**

From Newchwang, Manchuria. "(No. 295a, May 19, 1906.) Melon seeds obtained from Rev. J. Carson, of Newchwang, who procured them from a party from Australia. Said to be good for jam." (*Meyer.*)

20046. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Liaoyang, Manchuria. (No. 298a, June 4, 1906.)

20047. BRASSICA JUNCEA. **Chinese mustard.**

From Liaoyang, Manchuria. "(No. 299a, June 4, 1906.) Chinese name *Tje chwa*. The leaves and lower stalks are eaten either fresh or pickled." (*Meyer.*)

20048. LACTUCA SATIVA. **Lettuce.**

From Liaoyang, Manchuria. "(No. 300a, June 4, 1906.) Chinese name *Sun tsay*. Probably not to be compared with our lettuce, but may be useful in breeding." (*Meyer.*)

20001 to 20229—Continued.

20049. LACTUCA SATIVA. **Lettuce.**

From Shan-hai-kwan, China. "(No. 301a, Apr. 23, 1906.) Chinese name *Chin tsi*. For description see No. 300a (S. P. I. No. 20048)." (*Meyer.*)

20050. BETA VULGARIS. **Beet.**

From Liaoyang, Manchuria. "(No. 302a, June 4, 1906.) Chinese name *Kun to tsay*. The leaves are used as a vegetable." (*Meyer.*)

20051. CUCUMIS SATIVUS. **Cucumber.**

From Liaoyang, Manchuria. "(No. 303a, June 20, 1906.) Chinese name *Gwan kwa*. A long, green cucumber used as an early vegetable. Grows on trellises made from sorghum stalks and in warm sheltered situations." (*Meyer.*)

20052. LAGENARIA VULGARIS. **Gourd.**

From Liaoyang, Manchuria. "(No. 304a, June 4, 1906.) Chinese name *Gu tsa*. A gourd eaten boiled as a vegetable; when young it is also pickled in brine." (*Meyer.*)

20053. ALLIUM SATIVUM. **Garlic.**

From Liaoyang, Manchuria. (No. 305a, June 4, 1906.)

20054. ALLIUM CEPA. **Onion.**

From Liaoyang, Manchuria. "(No. 306a, June 4, 1906.) An inferior Chinese onion; used sparingly as a vegetable, not being strong enough to suit the Celestial palate." (*Meyer.*)

20055. SONCHUS sp.

From Musan, northern Korea. "(No. 307a, Aug. 29, 1906.) A wild vegetable, the young leaves of which are usually served raw as a salad, but they are also sometimes boiled. It tastes like the dandelion and is well worth trying. Can probably be easily forced. However, on sandy loam it is sometimes a bad weed, so I would recommend to be quite careful with it in testing." (*Meyer.*)

20056. CANNABIS SATIVA. **Hemp.**

From Yentai, Manchuria. "(No. 281a, June 1, 1906.) Chinese name *Shem ma*. These seeds come from the rich plain between Mukden and Liaoyang, where the soil is a heavy yellow loam. The seeds are thickly sown broadcast and the stems are harvested when they begin to set seeds." (*Meyer.*)

20057. CANNABIS SATIVA. **Hemp.**

From Liaoyang, Manchuria. "(No. 282a, June 2, 1906.) Chinese name *Shem ma*. Probably the same as No. 281a (S. P. I. No. 20056)." (*Meyer.*)

20058. CANNABIS SATIVA. **Hemp.**

From Newchwang, Manchuria. "(No. 283a, May 22, 1906.) Seed obtained from Mr. T. Sammons, American consul-general, Newchwang, who obtained the seeds from Hai-tcheng, Manchuria. This is a fine variety of hemp." (*Meyer.*)

(See S. P. I. No. 17528.)

20059. ABUTILON AVICENNAE. **China jute.**

From Newchwang, Manchuria. "(No. 284a, May 22, 1906.) Seed obtained from Mr. T. Sammons, American consul-general, Newchwang, who obtained the seed from Hai-tcheng, Manchuria. This is a coarse variety of hemp used for rope making." (*Meyer.*)

(See S. P. I. No. 17529.)

20001 to 20229—Continued.

20060. Abutilon avicennae. **China jute.**

From Hun-chun, Manchuria. "(No. 287a, Sept. 9, 1906.) Chinese name *Pai ma*. Seed of a red-stemmed variety of Abutilon; apparently a sport from the white variety. The fiber is used for rope making." (*Meyer.*)

20061. Papaver somniferum. **Opium poppy.**

From Antung, Manchuria. "(No. 285a, July 12, 1906.) Plants grow in a rather light, black soil, and the seed is sown in rows as soon as the frost leaves the soil." (*Meyer.*)

20062. Papaver somniferum. **Opium poppy.**

From near Antung, Manchuria. "(No. 286a, July 2, 1906.) This poppy is cultivated in large fields near Antung. A field in full bloom presents a color spectacle well worth seeing, the colors of the petals ranging from pure white to almost black purple. The individual colors may show marked differences in opium production. The soil is a rather poor blackish one, with much stony matter thrown in." (*Meyer.*)

20063. Nicotiana chinensis. **Tobacco.**

From Tan-ti-ku-li, northern Korea. "(No. 288a, Aug. 6, 1906.) A large-leaved tobacco seen here and there, and is a far superior variety to the ordinary kinds." (*Meyer.*)

20064. (Undetermined.)

From Hoi-ryong, northern Korea. "(No. 289a, Sept. 4, 1906.) Seed of a plant said to come from southern Korea. The berries are used in dyeing ribbons a deep orange color; they are, however, said to be quite poisonous. Probably a Solanaceae." (*Meyer.*)

20065. Capsicum annuum. **Red pepper.**

From Liaoyang, Manchuria. "(No. 296a, June 20, 1906.) Chinese name *La djo*. A large variety of Chili pepper grown in the market gardens around Liaoyang." (*Meyer.*)

20066. Capsicum annuum. **Red pepper.**

From Liaoyang, Manchuria. "(No. 297a, June 5, 1906.) A small-fruited variety of Chili pepper grown more or less for ornament and also for a condiment." (*Meyer.*)

20067. Prunus armeniaca. **Apricot.**

From Antung, Manchuria. "(No. 335a, July 10, 1906.) A large, reddish apricot with solid flesh; said to come from Chefoo, China." (*Meyer.*)

20068. Prunus armeniaca. **Apricot.**

From Musan, northern Korea. "(No. 336a, July 16, 1906.) Apricots growing in semiwild state in the mountains. The trees grow to large sizes, but the fruits are of inferior flavor and size." (*Meyer.*)

20069. Prunus armeniaca. **Apricot.**

From the mountains near Musan, northern Korea. "(No. 337a, July 20, 1906.) A wild apricot growing to a medium-sized tree and having very corky bark and large, heavily serrated leaves. Fruits small and inedible. May be a good stock plant for the colder regions, or can be used as a park tree in the Atlantic Coast States." (*Meyer.*)

20070. Prunus armeniaca. **Apricot.**

From Ai-djou, northern Korea. "(No. 338a, July 16, 1906.) A wild, bushy apricot growing in the dry, rocky mountains; produces small, scarcely edible fruits." (*Meyer.*)

20001 to 20229—Continued.

20071. Prunus armeniaca. **Apricot.**

From near Tchang-song, northern Korea. "(No. 339a, July 21, 1906.) Wild apricot seeds from a very tall tree, which was about 40 feet high and of which the trunk measured 10 feet in circumference a few feet above the soil. Can be used as a shade tree in parks. Fruits small and worthless." (*Meyer.*)

20072. Prunus armeniaca. **Apricot.**

From Liaoyang, Manchuria. "(No. 340a, June 21, 1906.) A red apricot grown in the gardens of Liaoyang, all the trees being seedlings; fruit medium sized and of very sweet flavor." (*Meyer.*)

20073. Prunus sp. **Plum.**

From the mountains of northern Korea. "(No. 341a, Aug., 1906.) A very bushy wild plum growing along creeks and moist places. The fruits are medium sized and very sour. May be used as a stock plant or for hybridization." (*Meyer.*)

20074. Prunus sp. **Plum.**

From Antung, Manchuria. "(No. 342a, July 10, 1906.) A very large yellow plum obtained in Antung, but said to come from Chefoo." (*Meyer.*)

20075. Prunus sp. **Cherry.**

From Fong-whan-cheng, Manchuria. "(No. 343a, July 1, 1906.) This edible bush cherry is a very ornamental shrub when in full fruit. The fruits make fine preserves." (*Meyer.*)

20076. Prunus sp.

From Sha-ho, Manchuria. "(No. 344a, June 26, 1906.) A shrubby Prunus growing in a rocky ravine; perhaps an ornamental hardy bush." (*Meyer.*)

20077. Prunus sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 345a, Aug. 11, 1906.) A large-leaved chokecherry bearing large racemes of cherries in profusion. Grows to be a small tree or a large shrub. In the fall the leaves assume very brilliant hues. May be of use as an ornamental park plant." (*Meyer.*)

20078. Prunus sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 346a, Aug., 1906.) Seed collected in different places. In all probability different strains will appear from this seed, for some bushes showed marked small differences in comparison with others." (*Meyer.*)

20079. Prunus sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 347a, Aug. 6, 1906.) A very ornamental chokecherry with large, ovate, lanceolate leaves. Can be used as a small ornamental tree in parks." (*Meyer.*)

20080. Prunus glandulifolia. **Chokecherry.**

From the mountains of northern Korea. "(No. 348a, Aug. 9, 1906.) A small-leaved, ornamental chokecherry. May be useful in parks and in gardens. The straight young stems may be useful for making smoking-pipe stems, and the heavier pieces of the trunk produce fine wood for small furniture." (*Meyer.*)

20081. Prunus sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 349a, Aug. 21, 1906.) A small-leaved chokecherry with slender, drooping branches. An ornamental small tree for parks and gardens." (*Meyer.*)

20001 to 20229—Continued.

20082. PRUNUS sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 350a, Aug. 11, 1906.) A broad-leaved, bushy chokecherry growing in rocky places. May be of use as an ornamental shrub for parks; seems to be very hardy." (*Meyer.*)

20083. PRUNUS sp. **Chokecherry.**

From the mountains of northern Korea. "(No. 351a, Aug. 9, 1906.) A species of chokecherry with large leaves which are quite hirsute, especially underneath. Well adapted as an ornamental tall shrub for parks and gardens." (*Meyer.*)

20084. PRUNUS sp. **Cherry.**

From the mountains of northern Korea. "(No. 352a, Aug. 21, 1906.) A small wild cherry; fruits black and inedible. The shrub or small tree is quite handsome in appearance and can be used in gardens and parks. Only two or three trees seen during the whole trip through northern Korea and only two had a few seeds." (*Meyer.*)

20085. PRUNUS PUMILA. **Sand cherry.**

From the mountains of northern Korea. "(No. 353a, Aug. 20, 1906.) A large-fruited form; fruits very sour and inedible." (*Meyer.*)

20086. PRUNUS PUMILA. **Sand cherry.**

From Musan, northern Korea. "(No. 354a, Aug. 29, 1906.) A sand cherry with large fruits produced in great abundance; fruits not sour, though not of good quality. May be improved or used in parks, gardens, or rockeries; as a bush in full bearing is decidedly beautiful. Height of bushes, 2 to 3 feet." (*Meyer.*)

20087. PRUNUS PUMILA. **Sand cherry.**

From Shako-san, northern Korea. "(No. 355a, Aug. 1, 1906.) A sand cherry growing on the banks of the Yalu River. For description, see No. 354a (S. P. I. No. 20086)." (*Meyer.*)

20088. PRUNUS PUMILA. **Sand cherry.**

From the mountains of northern Korea. "(No. 356a, July 22, 1906.) A heavy-bearing, though very small-fruited, sand cherry; not edible. For description see No. 354a (S. P. I. No. 20086)." (*Meyer.*)

20089. PINUS KORAIENSIS. **Pine.**

From Ai-djou, northern Korea. "(No. 333a, July 14, 1906.) An edible pine nut obtained in Ai-djou; is produced by a tall, bluish pine which I afterwards saw in the forests near Pek-to-san. It is an excellent timber tree, growing to be 150 feet tall and making a straight, clean stem." (*Meyer.*)

20090. PINUS KORAIENSIS. **Pine.**

From Vladivostok, Siberia. "(No. 334a, Sept. 20, 1906.) Edible pine seeds bought at a Chinese fruit stand in Vladivostok. Probably the same as No. 333a (S. P. I. No. 20089)." (*Meyer.*)

20091. PINUS THUNBERGII. **Japanese black pine.**

From the mountains of northern Korea. "(No. 504a, Sept. 1, 1906.) A beautiful pine with light green foliage and making dense, round heads; also a good lumber tree. Grows in the driest of situations and on very poor soil; does not grow, though, at great altitudes, so will probably not bear any severe cold. Of use as an ornamental park tree." (*Meyer.*)

20092. ZIZYPHUS SATIVA. **Jujube.**

From Vladivostok, Siberia. "(No. 505a, Sept. 26, 1906.) A large-fruited 'date' obtained at Vladivostok, where the Chinese import them from Chefoo, China." (*Meyer.*)

20001 to 20229—Continued.

20093. SOPHORA JAPONICA. **Japanese pagoda tree.**

From Liaoyang, Manchuria. "(No. 368a, June 4, 1906.) A much smaller variety of Sophora than is generally seen, growing as a shrub or a small tree with smaller leaves, branches, pods, etc.; quite ornamental and well worth growing. Only a few trees seen in a yard near Liaoyang." (*Meyer.*)

20094. COLUTEA sp.

From Port Arthur, Manchuria. "(No. 369a, May 14, 1906.) Probably *Colutea fruticosa.* Used in the parks in Port Arthur as an ornamental shrub. As the climate there is very dry, the shrubs and trees from there will thrive in semiarid regions." (*Meyer.*)

20095. AMORPHA sp.

From Port Arthur, Manchuria. (No. 370a, May 14, 1906.)

20096. (Undetermined.)

From Port Arthur, Manchuria. "(No. 371a, May 14, 1906.) A shrub of bushy habit, with slender branches and lanceolate leaves, growing in the parks of Port Arthur along the sidewalks; well adapted for this purpose." (*Meyer.*)

20097. XANTHOXYLUM AILANTHOIDES.

From Port Arthur, Manchuria. "(No. 372a, May 14, 1906.) A small ornamental tree growing in the parks in Port Arthur." (*Meyer.*)

20098. ELAEAGNUS sp.

From Port Arthur, Manchuria. "(No. 373a, May 15, 1906.) An Elaeagnus with silvery leaves and bearing white berries; grows to be a tall shrub with long branches. Quite beautiful when seen in clumps." (*Meyer.*)

20099. ELAEAGNUS sp.

From Port Arthur, Manchuria. "(No. 374a, May 15, 1906.) A variety with black seeds; grows to be somewhat larger than the preceding one; otherwise the same remarks apply to it." (*Meyer.*)

20100. TILIA MANDSHURICA. **Linden.**

From near Mukden, Manchuria. "(No. 375a, May 29, 1906.) A very large leaved linden from the forest around the Imperial East Tomb, near Mukden. A handsome tree, of which the leaves sometimes reach the size of 1 foot across in each direction." (*Meyer.*)

20101. ARALIA sp.

From A-teuk-ryong, northern Korea. "(No. 376a, Aug. 10, 1906.) A low ornamental shrub, with handsome, large, light green leaves and bearing large clusters of scarlet berries. Grows in shady places in the primeval forests; seems to prefer leaf mold." (*Meyer.*)

20102. ARALIA sp.

From Tchong-ping, northern Korea. "(No. 377a, Aug. 19, 1906.) A shrubby Aralia growing from 5 to 10 feet tall, with palmately divided leaves and bearing an abundance of black berries in umbels." (*Meyer.*)

20103. ARALIA MANDSHURICA.

From Possiet, Siberia. "(No. 378a, Sept. 10, 1906.) A very large leaved Aralia, the leaves sometimes becoming 3 to 4 feet long. Seems to be very hardy and drought resistant." (*Meyer.*)

20001 to 20229—Continued.

20104. ACANTHOPANAX SESSILIFLORUM.

From Liaoyang, Manchuria. "(No. 379a, June 1, 1906.) An Aralia-like shrub growing in the Scottish mission garden in Liaoyang. May be utilized in parks and large gardens; not as ornamental, perhaps, as could be wished for, but apparently very hardy and drought resistant." (*Meyer.*)

20105. CRATAEGUS SANGUINEA. **Hawthorn.**

From the mountains of northern Korea. "(No. 380a, Aug., 1906.) A very hardy, ornamental Crataegus growing as a tall shrub or small tree. Has light green, somewhat tomentose foliage, and is covered in the fall with orange-scarlet berries. The berries are edible, but are rather flat and mealy to our taste. Well adapted for planting in parks." (*Meyer.*)

20106. CRATAEGUS SANGUINEA. **Hawthorn.**

From the mountains near the source of the Tumen River, northern Korea. "(No. 381a, Aug. 27, 1906.) Seeds from trees growing at high altitudes, over 3,000 feet, and apparently the limit zone of this Crataegus. Ought to be hardier than No. 380a (S. P. I. No. 20105); otherwise the same description applies to it." (*Meyer.*)

20107. CRATAEGUS SANGUINEA. **Hawthorn.**

From the mountains of northern Korea. "(No. 382a, Aug. 5, 1906.) A variety bearing yellow berries; not as handsome as the usual type." (*Meyer.*)

20108. CRATAEGUS PINNATIFIDA. **Hawthorn.**

From the mountains of northern Korea. "(No. 383a, Aug. 28, 1906.) A variety having very finely pinnate leaves. The fruits are much smaller and ripen later than those of the usual type. This may be a distinct variety or strain." (*Meyer.*)

20109. CRATAEGUS PINNATIFIDA. **Hawthorn.**

From the mountains of northern Korea. "(No. 384a, Aug. 28, 1906.) A variety quite handsome in appearance, having large, glossy, dark green leaves; bears very few fruits, however." (*Meyer.*)

20110. SORBUS sp.

From the mountains of northern Korea. "(No. 385a, Aug. 27, 1906.) A Sorbus seen usually as a shrub, but in the forests it grows to be a tall, slender tree; apparently a very scant bearer, as I saw only two shrubs in fruit, but the large clusters of yellow berries contrast beautifully with the tender, pinnate foliage." (*Meyer.*)

20111. BERBERIS sp. **Barberry.**

From the mountains of northern Korea. "(No. 386a, Aug. 28, 1906.) A large-leaved Berberis growing 6 to 10 feet tall and bearing many racemes of red berries." (*Meyer.*)

20112. BERBERIS sp. **Barberry.**

From the mountains of northern Korea. "(No. 387a, Sept. 2, 1906.) A large-leaved Berberis from a different locality than the preceding one; otherwise the same remarks apply to it." (*Meyer.*)

20113. ROSA sp. **Rose.**

From northern Korea. "(No. 388a, Aug., 1906.) Fruits collected from rose bushes in different parts of northern Korea; probably several distinct species." (*Meyer.*)

20001 to 20229—Continued.

20114. Sambucus racemosa. **Elder.**

From the mountains of northern Korea. "(No. 389a, Aug., 1906.) Seed collected from bushes growing at an altitude of from 4,000 to 5,000 feet. The bushes at these altitudes do not grow higher than 4 or 5 feet, but are extremely beautiful, being loaded with large clusters of scarlet berries, which contrast vividly with the bright green, glossy foliage. This is a very hardy shrub, growing on the poorest of soils and really looking better in colder climes than in the warmer altitudes. Perhaps a good shrub for the Northwestern States." (*Meyer.*)

20115. Viburnum sp.

From the mountains of northern Korea. "(No. 390a, Aug. 20, 1906.) A Viburnum with rather small, light green leaves and bearing small umbels of white flowers, followed by berries which turn from green to red, and when ripe to jet black. Grows from 4 to 10 feet high. Seems to prefer calcareous rocky soil." (*Meyer.*)

20116. Viburnum sp.

From the mountains of northern Korea. "(No. 391a, Aug. 28, 1906.) Collected in a different locality and from taller shrubs than No. 390a; otherwise the same remarks apply to it." (*Meyer.*)

20117. Betula sp. **Birch.**

From the mountains of northern Korea. "(No. 392a, Aug. 11, 1906.) A beautiful white birch, the bark of which is used as roofing material in the mountain regions, also for illuminating purposes, taking the place of our lamps and candles. In the forests this tree grows to be over 100 feet tall, but solitary specimens never reach that size." (*Meyer.*)

20118. Betula sp. **Birch.**

From Tchong-ping, northern Korea. "(No. 393a, Aug. 20, 1906.) A very low, bushy, dwarf birch, with blackish bark, growing 3 to 4 feet high, on a cold plain, high in the mountains, where the soil consisted of black peat. Used locally for making brooms." (*Meyer.*)

20119. Betula sp. **Birch.**

From the mountains of northern Korea. "(No. 394a, Aug. 15, 1906.) A bush birch, 6 to 10 feet tall, growing in a high mountain valley, only two or three specimens together." (*Meyer.*)

20120. Cornus sp. **Dogwood.**

From near Tchang-song, northern Korea. "(No. 395a, July 20, 1906.) A tall-growing tree, with beautiful, large leaves; quite rare in southern Manchuria and northern Korea." (*Meyer.*)

20121. Cornus sp. **Dogwood.**

From the mountains of northern Korea. "(No. 396a, Aug. 11, 1906.) A medium-sized shrub, growing mostly in rocky soil along water courses. Has large, light green leaves and reddish colored twigs, and is sometimes loaded with clusters of white berries." (*Meyer.*)

20122. Spiraea sp. **Spirea.**

From the mountains of northern Korea. "(No. 397a, Aug. 11, 1906.) A very shrubby Spiraea 4 to 5 feet tall, found growing along rocky ravines." (*Meyer.*)

20123. Spiraea sp. **Spirea.**

From Tchien-shan Mountains, Manchuria. "(No. 398a, June 9, 1906.) A Spiraea found growing on rocky, exposed places in the mountains." (*Meyer.*)

20001 to 20229—Continued.

20124. (Undetermined.)

From near Tchang-song, northern Korea. "(No. 399a, July 20, 1906.) A shrub with rather large leaves, growing in shady ravines." (*Meyer.*)

20125. CARAGANA sp.

From the mountains at the source of the Tumen River, northern Korea. (No. 400a, Aug. 27, 1906.)

20126. JUNIPERUS CHINENSIS.

From Liaoyang, Manchuria. "(No. 401a, June 4, 1906.) This tree thrives but poorly at Liaoyang, it being too cold for it." (*Meyer.*)

20127. LESPEDEZA sp.

From Tchien-shan Mountains, Manchuria. "(No. 402a, June 8, 1906.) A small, ornamental shrub, bearing many racemes of rosy colored flowers; thrives on high, dry land. Of use in gardens and along embankments as a low, ornamental shrub." (*Meyer.*)

20128. SALIX sp. **Willow.**

From the mountains of northern Korea. "(No. 403a, Aug. 15, 1906.) For description see No. 529 (S. P. I. No. 19527)." (*Meyer.*)

20129. (Undetermined.)

From the mountains of northern Korea. "(No. 404a, Aug. 20, 1906.) A woody climber, with large, light green leaves and bearing panicles of small, whitish green flowers, followed by large quantities of three-winged seeds. Apparently can stand low temperatures, as it is even found on high mountain tops." (*Meyer.*)

20130. (Undetermined.)

From northern Korea. "(No. 405a, Aug. 11, 1906.) Seed of a low bush growing on wet, peaty soil and having glossy green, ovate, lanceolate leaves and bearing scarlet berries." (*Meyer.*)

20131. AZALEA sp. **Azalea.**

From the mountains near Musan, northern Korea. "(No. 406a, July 16, 1906.) A shrubby Azalea bearing pale purplish flowers, found growing in the mountains." (*Meyer.*)

20132. (Undetermined.)

From the mountains of northern Korea. "(No. 407a, July 20, 1906.) A low, ornamental shrub looking like a Spiraea, but with raspberry-like leaves, found growing in profusion along a shady road." (*Meyer.*)

20133. RHAMNUS sp. **Buckthorn.**

From the mountains of northern Korea. "(No. 408a, Aug. 28, 1906.) An ornamental Rhamnus, with broad, light green leaves, growing usually as a large shrub, but seen occasionally as a small tree." (*Meyer.*)

20134. RHAMNUS sp. **Buckthorn.**

From the mountains of northern Korea. "(No. 409a, Aug. 15, 1906.) A small-leaved Rhamnus of very dense growth. Well adapted for use as a hedge and for dwarfing and clipping purposes." (*Meyer.*)

20135. RHAMNUS sp. **Buckthorn.**

From the mountains of northern Korea. "(No. 410a, Aug. 20, 1906.) A small-leaved Rhamnus of not as dense growth as the preceding; otherwise the same remarks apply to it." (*Meyer.*)

20001 to 20229—Continued.

20136. AMELANCHIER sp (?).

From the mountains of northern Korea. "(No. 411a, Aug., 1906.) A shrub bearing small, inedible fruits like crab apples and with leaves like a small *Viburnum opulus*. Seems to prefer shady spots in the higher altitudes." (*Meyer.*)

20137. MALUS sp. **Crab apple.**

From the mountains of northern Korea. "(No. 412a, Aug. 20, 1906.) A few seeds of a wild crab apple bearing very small, hard fruits. Grows usually as a shrub, but in sheltered places becomes a tree." (*Meyer.*)

20138. EUONYMUS sp.

From the mountains of northern Korea. "(No. 413a, Aug. 28, 1906.) A small-leaved, hardy Euonymus, growing very compactly." (*Meyer.*)

20139. EUONYMUS sp.

From the mountains of northern Korea. "(No. 414a, Aug. 28, 1906.) A dense-growing, small-leaved bush, with corky wings along its branches." (*Meyer.*)

20140. EUONYMUS sp.

From the mountains of northern Korea. "(No. 415a, Aug. 9, 1906.) A large-leaved Euonymus growing in dense shade in the forest and bearing four-winged fruits." (*Meyer.*)

20141. LONICERA sp. **Honeysuckle.**

From the mountains of northern Korea. "(No. 416a, Aug. 12, 1906.) A large-leaved Lonicera, with large, scarlet berries." (*Meyer.*)

20142. LONICERA sp. **Honeysuckle.**

From the mountains of northern Korea. "(No. 417a, Aug. 12, 1906.) A medium-sized, bushy honeysuckle growing in large masses and bearing scarlet berries." (*Meyer.*)

20143. LONICERA sp. **Honeysuckle.**

From the mountains of northern Korea. "(No. 418a, Aug. 12, 1906.) A low, bush honeysuckle with bright green, medium-sized leaves and scarlet berries." (*Meyer.*)

20144. LONICERA sp. **Honeysuckle.**

From the mountains of northern Korea. "(No. 419a, Aug. 21, 1906.) A bushy honeysuckle growing 10 to 12 feet high; leaves larger and darker green than the ordinary type." (*Meyer.*)

20145. LONICERA sp. **Honeysuckle.**

From Bo-tau-shan Mountains, northern Korea. "(No. 420a, Aug. 24, 1906.) A low, shrubby honeysuckle, 3 to 4 feet high, bearing pretty blue berries of repulsive taste. These shrubs grow only at high altitudes and may be used in the colder parts of the United States as ornamental garden shrubs." (*Meyer.*)

20146. LONICERA sp. **Honeysuckle.**

From Sa-mai-tsi, Manchuria. "(No. 421a, July 27, 1906.) A large, bushy honeysuckle, becoming somewhat shaggy when old. When young, however, it is a fine shrub, bearing thousands of small, white, fragrant flowers." (*Meyer.*)

20147. ALNUS sp. **Alder.**

From the mountains of northern Korea. "(No. 422a, Sept. 1, 1906.) A large-leaved alder growing along water courses; quite a handsome shrub." (*Meyer.*)

20001 to 20229—Continued.

20148. Alnus sp. **Alder.**

From near Tok-sil-tong, northern Korea. "(No. 423a, Aug. 12, 1906.) A large-leaved, dark green alder growing in rocky soil along a stream. Apparently grows to be only a tall shrub; at least no trees of it were seen." (*Meyer.*)

20149. Acer ginnala. **Maple.**

From the mountains of northern Korea. "(No. 424a, August, 1906.) A dwarf, bushy maple with small, scarcely lobed leaves and bearing an abundance of fruits, which assume beautiful rosy and red colors toward the end of summer. It is exported from the Yalu River to ports in China, where the shoots with leaves on them are used in the manufacture of a black dye." (*Meyer.*)

20150. Acer sp. **Maple.**

From the mountains of northern Korea. "(No. 425a, Aug. 16, 1906.) A tall, bushy maple with rather large, dark green leaves." (*Meyer.*)

20151. Acer ginnala. **Maple.**

From the mountains of northern Korea. "(No. 426a, Aug. 20, 1906.) A bushy maple with very slender branches and small leaves; probably a variety of No. 424a (S. P. I. No. 20149), and as such the same description applies to it." (*Meyer.*)

20152. Acer sp. **Maple.**

From the mountains of northern Korea. "(No. 427a, Aug. 21, 1906.) A rather large leaved maple growing to be a very tall shrub or sometimes a small tree; always found growing between other trees and not as solitary specimens in open spaces." (*Meyer.*)

20153. Acer sp. **Maple.**

From the mountains of northern Korea. "(No. 428a, Aug. 21, 1906.) A large-leaved maple growing to be a tall shrub or a small tree in the dense forests." (*Meyer.*)

20154. Paeonia sp. **Peony.**

From Bo-tau-shan Mountains, northern Korea. "(No. 429a, Aug. 23, 1906.) A wild peony growing in the primeval forest at high altitudes, 3,000 to 4,000 feet, on decomposed sandstone." (*Meyer.*)

20155. Saxifraga tabularis.

From the mountains of northern Korea. "(No. 430a, Aug. 27, 1906.) A Saxifraga having circular leaves which are sometimes over 1 foot in diameter. Grows in cool, shady places in the forests; prefers a sandy soil." (*Meyer.*)

20156. Saxifraga sp.

From the mountains near Musan, northern Korea. "(No. 431a, July 16, 1906.) A Saxifraga growing in the rocks in shady places. In the distance it looks exactly like a vigorous *Ampelopsis veitchii.*" (*Meyer.*)

20157. Dracocephalum sp.

From near Tchang-song, northern Korea. "(No. 432a, July 21, 1906.) An ornamental labiate with large, blue flowers; probably a perennial. Found only on sandy soil." (*Meyer.*)

20158. Asparagus sp.

From near Mai-mi-la, northern Korea. "(No. 433a, Aug. 12, 1906.) An ornamental wild asparagus with straight stems and beautiful, light green, feathery foliage; grows from 2 to 4 feet tall." (*Meyer.*)

(See S. P. I. No. 20357.)

20001 to 20229—Continued.

20159. AMARANTHUS sp.

From near Hunchun, Manchuria. "(No. 434a, Sept. 7, 1906.) An ornamental Amaranthus with large, drooping plumes of canary-yellow color." (*Meyer.*)

20160. AMARANTHUS sp.

From Newchwang, Manchuria. "(No. 435a, May 18, 1906.) Seed of an Amaranthus, which is said to be an ornamental garden plant, obtained from Rev. J. Carson, of Newchwang, who received the seed from Japan." (*Meyer.*)

20161. AMARANTHUS sp.

From Newchwang, Manchuria. "(No. 436a, May 17, 1906.) Seed of an Amaranthus which is grown for ornament in Chinese gardens and of which the young seedlings are also used as a vegetable. Chinese name *Lao lai pien.* Obtained from Rev. J. Carson, of Newchwang." (*Meyer.*)

20162. DELPHINIUM sp. **Larkspur.**

From Newchwang, Manchuria. "(No. 437a, May 18, 1906.) A dark blue, perennial larkspur, of use as an ornamental garden plant in dry, cold regions. Seeds obtained from Rev. J. Carson, who received them from a friend in Kai-chow, Manchuria." (*Meyer.*)

20163. (Undetermined.)

From Newchwang, Manchuria. "(No. 438a, May 18, 1906.) A wild composite known as 'autumn daisy.' Seed obtained from Rev. J. Carson." (*Meyer.*)

20164. ANEMONE sp.

From Fong-whang-shen, Manchuria. "(No. 439a, June 30, 1906.) A wild anemone found only on sandy soil; probably an ornamental." (*Meyer.*)

20165. REHMANNIA GLUTINOSA.

From Liaoyang, Manchuria. "(No. 440a, June 21, 1906.) An ornamental plant found growing on the city walls of Peking and Liaoyang. Has rather large spikes of brownish purple flowers." (*Meyer.*)

20166. ALTHAEA ROSEA. **Hollyhock.**

From Hunchun, Manchuria. "(No. 441a, Sept. 8, 1906.) A large-flowered hollyhock of dark purple color; grown as an ornamental plant in Chinese gardens." (*Meyer.*)

20167. SCABIOSA CAUCASICA.

From northern Korea. "(No. 442a, Sept. 2, 1906.) An ornamental Scabiosa with large, deep blue flowers." (*Meyer.*)

20168. ASTER sp. **Aster.**

From near Musan, northern Korea. "(No. 443a, Aug. 29, 1906.) A herbaceous, perennial composite growing 2 or 3 feet high; has but few stalks and bears many flowers with yellow centers and dark blue rays." (*Meyer.*)

20169. (Undetermined.)

From the mountains of northern Korea. "(No. 444a, Aug. 11, 1906.) A composite bearing large flowers having a yellow center and blue rays; bears but a few flowers to each stalk. Grows from a few inches to 1 foot tall." (*Meyer.*)

20001 to 20229—Continued.

20170. Callistephus hortensis.

From the mountains of northern Korea. "(No. 445a, Sept. 3, 1906.) Seed of the wild form of our garden aster, found growing in great profusion in the mountains of northeast Korea. A beautiful plant that might be naturalized in the United States, especially in the Rocky Mountain regions." (*Meyer.*)

20171. Dianthus chinensis.

From the mountains of northern Korea. "(No. 446a, Sept. 3, 1906.) A beautiful scarlet pink." (*Meyer.*)

20172. Taraxacum sp.

From North Tomb, Mukden, Manchuria. "(No. 447a, May 28, 1906.) A white-flowering dandelion." (*Meyer.*)

20173. Viola sp. **Violet.**

From the mountains of northern Korea. "(No. 448a, Aug. 15, 1906.) A violet having small leaves which exactly resemble the Cyclamen." (*Meyer.*)

20174. Aquilegia sp. **Columbine.**

From the forest of Bo-tau-shan, northern Korea. "(No. 449a, Aug. 25, 1906.) A columbine with yellow-brown flowers." (*Meyer.*)

20175. Sedum sp.

From Ai-djou, northern Korea. "(No. 450a, July 17, 1906.) A low-growing, yellow-flowering Sedum well adapted for rockeries; grows very compactly and covers large expanses; seems to prefer rocky or sandy situations." (*Meyer.*)

20176. Lychnis sp.

From the mountains of northern Korea. "(No. 451a, Aug. 22, 1906.) A Lychnis with rather large, bright scarlet flowers but of somewhat weedy growth. If it can be improved it will be a good garden plant." (*Meyer.*)

20177. Astilbe sp.

From the mountains of northern Korea. "(No. 452a, July 19, 1906.) A rather tall growing Astilbe with large, bluish colored spikes; found growing in moist localities on peaty soil." (*Meyer.*)

20178. Actaea sp.

From the mountains of northern Korea. "(No. 453a, Aug. 23, 1906.) A plant with large bipinnate leaves and bearing spikes with berries of a striking red color; found growing in a dense forest." (*Meyer.*)

20179. Glycyrrhiza sp.

From near Liaoyang, Manchuria. "(No. 454a, June 1, 1906.) A rather handsome wild plant which is green when other vegetation has just commenced to grow. This plant grows in the driest of situations; is not eaten by animals and may be poisonous." (*Meyer.*)

20180. Lycium sp.

From Hoi-ryong, northern Korea. "(No. 455a, Sept. 3, 1906.) A wild matrimony vine with rather large scarlet berries; in the wild state the branches grow 3 to 5 feet long." (*Meyer.*)

20181. Clematis sp. **Clematis.**

From the mountains of northern Korea. "(No. 456a, Aug. 28, 1906.) A large-growing clematis with white flowers; not highly ornamental, as the panicles with flowers are not dense enough and the individual flowers do not all blossom at the same time." (*Meyer.*)

20001 to 20229—Continued.

20182. Adlumia sp.

From the mountains of northern Korea. "(No. 457a, Aug. 23, 1906.) An ornamental, perennial climber with graceful foliage and bearing many racemes of drooping rosy flowers." (*Meyer.*)

20183. Ricinus communis. **Castor-oil plant.**

From northern Korea. "(No. 458a, Aug. 5, 1906.) A cultivated variety of the spineless castor bean found growing among plants of the spiny variety." (*Meyer.*)

20184. (Undetermined.)

From Tchien-shan Mountains, Manchuria. "(No. 459a, June 7, 1906.) An umbelliferous plant, the rhizome of which is used for medicinal purposes by the Chinese. This plant was found growing on dry, shady spots in decomposed rock." (*Meyer.*)

20185. Iris sp. **Iris.**

From northern Korea. "(No. 460a, Aug. 29, 1906.) An early flowering iris of northern China, Manchuria, and northern Korea growing on very dry ground; flowers pale blue." (*Meyer.*)

20186. Iris sp. **Iris.**

From the mountains of northern Korea. "(No. 461a, Aug. 24, 1906.) An iris found growing in a wet meadow. This is a very rare plant and may be an ornamental." (*Meyer.*)

20187. Hemerocallis sp.

From the mountains of northern Korea. "(No. 462a, Aug. 25, 1907.) An ornamental garden plant bearing large, sulphur-yellow flowers which open at sunset; the flowers have a pleasant odor." (*Meyer.*)

20188. Hemerocallis sp.

From the mountains of northern Korea. "(No. 463a.) An ornamental garden perennial growing in high altitudes." (*Meyer.*)

20189. Pardanthus sp.

From the mountains of northern Korea. "(No. 464a, Aug. 28, 1906.) An ornamental garden perennial." (*Meyer.*)

20190. Paris sp.

From the primeval forest of Bo-tau-shan, northern Korea. (No. 465a, Aug. 23, 1906.)

20191. Convallaria sp.

From A-teuk-ryong, northern Korea. "(No. 466a, Aug. 10, 1906.) Plant bears red berries on stalks which resemble *C. polygonatum.*" (*Meyer.*)

20192. (Undetermined.)

From the mountains of northern Korea. "(No. 467, Aug. 13, 1906.) A rather ornamental, broad-leaved liliaceous plant growing at high elevations in the dense forest and bearing a spike with blue berries." (*Meyer.*)

20193. (Undetermined.)

From the primeval forest of Bo-tau-shan, northern Korea. "(No. 468a, Aug. 25, 1906.) Probably the same as No. 467a (S. P. I. No. 20192), but from a different locality." (*Meyer.*)

20194. (Undetermined.)

From the primeval forest of Bo-tau-shan, northern Korea. "(No. 439a, Aug. 25, 1906.) The same as Nos. 467a and 468a (S. P. I., Nos. 20192 and 20193), but bearing black berries." (*Meyer.*)

20001 to 20229—Continued.

20195. Rubus sp. **Blackberry.**

From the mountains of northern Korea. "(No. 357a, Aug. 1906.) A red blackberry of crawling habit, producing large panicles with many red berries. The taste is somewhat flat, however, and the seeds too conspicuous when eating them. May be improved, though, and become a good garden fruit. When grown in a somewhat shady place the fruits become much juicier. The underside of the leaves is tomentose and white." (*Meyer.*)

20196. Rubus sp. **Blackberry.**

From the mountains of northern Korea. "(No. 358a, July 25, 1906.) A red blackberry of erect habit, producing an abundance of small panicles with fruit. Has a good taste, though somewhat flat, but when eaten in quantity is quite acceptable. May be improved and become a garden fruit. Is closely related to the raspberry. The underside of the leaves is green. When grown in a shady place the leaves and fruits attain a larger size than when grown in the sun. Should be grown in good sandy or peaty soil." (*Meyer.*)

20197. Actinidia kolomikta.

From the mountains of northern Korea. "(No. 359a, Aug., 1906.) A climbing Actinidia growing very large and producing green berries ranging in size from a gooseberry to a plum and tasting like the former. The plants are usually scant bearers and do not warrant the space given to them when grown for fruit, but may be used as an ornamental vine, the silver and red leaves being quite beautiful." (*Meyer.*)

20198. Ribes rubrum. **Currant.**

From A-teuk-ryong, northern Korea. "(No. 361a, Aug. 10, 1906.) A wild red currant found growing in the mountains. The berries are of a large size but very sour. The shrubs are more vigorous than those seen in cultivation." (*Meyer.*)

20199. Ribes rubrum. **Currant.**

From the mountains of northern Korea. "(No. 362a, Aug. 14, 1906.) A form of the wild currant with erect racemes; the berries are tasteless; leaves very large, and the whole shrub is of larger dimensions than those seen in cultivation." (*Meyer.*)

20200. Ribes rubrum. **Currant.**

From the mountains of northern Korea. "(No. 363a, Aug. 6, 1906.) A different form of the wild currant from that commonly seen. It is very shrubby and produces fruits which are not sour but rather dry." (*Meyer.*)

20201. Ribes procumbens. **Currant.**

From the forest of Bo-tau-shan, northern Korea. "(No. 364a, Aug. 25, 1906.) A species of Ribes growing from 3 to 5 inches high in shady, moist places in the forest. The berries are the same size as the taller varieties but the leaves are somewhat smaller." (*Meyer.*)

20202. Ribes alpinum.

From A-teuk-ryong, northern Korea. "(No. 365a, Aug. 10, 1906.) A small currant which might be grown in shady places as a garden shrub." (*Meyer.*)

20203. Ribes alpinum.

From the forest of Bo-tau-shan, northern Korea. "(No. 366a, Aug. 26, 1906.) An ornamental currant with small, red, elongated berries." (*Meyer.*)

20204. Ribes sp.

From the mountains of northern Korea. "(No. 367a, Aug. 6, 1906.) A small, shrubby bush bearing yellow, inedible berries." (*Meyer.*)

20001 to 20229—Continued.

20205. POA PRATENSIS. **Kentucky bluegrass.**

From the mountains of northern Korea. "(No. 476a, Aug. 15, 1906.) A wild meadow grass which forms a dense turf. This grass is rarely seen and it may be a good lawn and pasturing grass." (*Meyer.*)

20206. ELYMUS SIBIRICUS.

From the mountains of northern Korea. "(No. 477a, Aug. 11, 1906.) A tall wild grass with drooping heads growing in sandy and stony places; may be sand binding." (*Meyer.*)

20207. AGROPYRON sp.

From the mountains of northern Korea. "(No. 478a, Aug. 14, 1906.) A medium tall wild grass with drooping heads and scanty foliage, growing in stony places." (*Meyer.*)

20208. ERAGROSTIS sp.

From the mountains of northern Korea. "(No. 479a, Aug. 14, 1906.) A very delicate plumed grass growing along trails and in cleared places through the forests." (*Meyer.*)

20209. POA TRIVIALIS. **Rough-stalked meadow grass.**

From the mountains of northern Korea. "(No. 480a, Aug. 22, 1906.) A grass with clean, round stems found growing at high altitudes (3,000 to 4,000 feet) in dense bunches on somewhat sandy soil." (*Meyer.*)

20210. PHALARIS ARUNDINACEA. **Reed canary grass.**

From the mountains of northern Korea. "(No. 481a, Aug. 14, 1906.) A tall, rough grass growing at high elevations on moist, peaty soil. Is a good fodder for horses and cattle." (*Meyer.*)

20211. ARUNDINELLA ANOMALA.

From the mountains of northern Korea. "(No. 482a, Aug. 28, 1906.) A tall, rough grass growing on high, dry soil. May be a fodder grass." (*Meyer.*)

20212. POA sp.

From the mountains of northern Korea. "(No. 483a, Aug. 14, 1906.) A grass of dense habits found growing in high altitudes. May be of use as a lawn and pasture grass." (*Meyer.*)

20213. CALAMAGROSTIS sp.

From the mountains of northern Korea. "(No. 484a, Aug. 14, 1906.) A tall, rough grass covering enormous areas where the forest has been burned; prefers a moist, peaty soil. Grows from 3 to 5 feet tall and is a very good fodder grass." (*Meyer.*)

20214. BECKMANNIA ERUCIFORMIS.

From near Antung, northern Korea. "(No. 485a, July 11, 1906.) A grass found growing on wet, muddy flats along the Yalu River; may be a fodder grass." (*Meyer.*)

20215. AGROPYRON sp.

From northern Korea. "(No. 486a, June 28, 1906.) A rough, bluegrass growing along shady roads; may be of use as a sand binder." (*Meyer.*)

20216. MISCANTHUS JAPONICUS.

From the mountains of northern Korea. "(No. 487a. Aug. 20, 1906.) A tall, rough grass with ornamental white plumes; used locally for fodder." (*Meyer.*)

20001 to 20229—Continued.

20217. SACCHARUM ARUNDINACEUM.

From near Hunchun, Manchuria. (No. 488a, Sept. 9, 1906.)

20218. PHALARIS ARUNDINACEA. **Reed canary grass.**

From A-teuk-ryong, northern Korea. "(No. 489a, Aug. 10, 1906.) A rough grass growing in the primeval forest; of use as a fodder grass." (*Meyer.*)

20219. ERIOCHLOA VILLOSA.

From the mountains of northern Korea. "(No. 490a, Aug. 20, 1906.) A grass of peculiar growth growing in a dry, sandy situation." (*Meyer.*)

20220. ERIOCHLOA VILLOSA.

From northern Korea. "(No. 491a, Sept. 6, 1906.) The same as No. 490a (S. P. I. No. 20219), but of a more vigorous growth." (*Meyer.*)

20221. CHLORIS sp.

From northern Korea. "(No. 492a, Sept. 3, 1906.) A grass growing on very dry, elevated plains and along roads in but one locality; probably not very valuable." (*Meyer.*)

20222. MELICA sp.

From Liaoyang, Manchuria. "(No. 493a, June 21, 1906.) A graceful grass growing on the dry, exposed city wall of Liaoyang; may be of use in the very dry regions of the United States." (*Meyer.*)

20223. AGROPYRON SIBIRICUM (?).

From Liaoyang, Manchuria. "(No. 494a, June 21, 1906.) A coarse grass growing on the dry, exposed city wall of Liaoyang." (*Meyer.*)

20224. POA TRIVIALIS. **Rough-stalked meadow grass.**

From Liaoyang, Manchuria. "(No. 495a, June 21, 1906.) A grass of good habit growing on the dry, exposed city wall of Liaoyang." (*Meyer.*)

20225. CAREX sp. **Sedge.**

From the mountains of northern Korea. "(No. 496a, Aug. 22, 1906.) A round-stemmed Carex growing on dry, high grounds. May be of use as a fodder plant." (*Meyer.*)

20226. CAREX sp. **Sedge.**

From the mountains of northern Korea. "(No. 497a, Aug. 22, 1906.) Probably identical with No. 496a (S. P. I. No. 20225)." (*Meyer.*)

20227. CAREX sp. **Sedge.**

From the mountains of northern Korea. "(No. 498a, Aug. 27, 1906.) A Carex grown in fields used as pasturing grounds for bulls and horses, which seem to like this sedge. Grows on somewhat moist, peaty soil. Of use as a fodder plant on moist lands in the Northern States." (*Meyer.*)

20228. SCIRPUS ERIOPHORUM.

From the mountains of northern Korea. "(No. 499a, Sept. 6, 1906.) A tall, rough Scirpus found on very dry ground; probably a good fodder plant." (*Meyer.*)

20229. SCIRPUS ERIOPHORUM.

From near Novo Kiowsk, Siberia. "(No. 500a, Sept. 9, 1906.) Identical with No. 499a (S. P. I. No. 20228), but found growing in a moist locality." (*Meyer.*)

20230 to 20288.

From Manchuria. Received through Mr. F. N. Meyer, agricultural explorer, March 12, 1907.

Cuttings of fruit trees, ornamentals, etc., as follows:

20230. MALUS sp. **Apple.**

From Kwang-cheng-tze. "(No. 575.) Chinese name *Sha ho tze*. A red apple with white cheeks." (*Meyer.*)

20231. MALUS sp. **Siberian crab apple.**

From Kwang-cheng-tze. "(No. 576.) Cuttings of the original Siberian crab apple growing at Kwang-cheng-tze and used for grafting stock for the better varieties." (*Meyer.*)

20232. PYRUS SINENSIS. **Pear.**

From Kwang-cheng-tze. "(No. 577.) The fragrant water pear, or *Hsiang suy li*, used dried and fresh in Manchuria." (*Meyer.*)

20233. PYRUS SINENSIS. **Pear.**

From Kwang-cheng-tze. "(No. 578.) Chinese name *Ya li*. A large pear, one of the best of north China." (*Meyer.*)

20234. PYRUS SINENSIS. **Pear.**

From Kwang-cheng-tze. "(No. 579.) The same as No. 578 (S. P. I. No. 20233), but said to be a somewhat different form." (*Meyer.*)

20235. PYRUS SINENSIS. **Pear.**

From Kwang-cheng-tze. "(No. 580.) Chinese name *Bay li*. A pear with rather hard, whitish yellow fruits." (*Meyer.*)

20236. SALIX sp. **Willow.**

From near Kwang-cheng-tze. "(No. 581.) A semiweeping willow with a straight stem and graceful, drooping branches hanging from its crown." (*Meyer.*)

20237. MALUS sp. **Crab apple.**

From San-tau-lin-tze. "(No. 582.) A tall-growing form of the wild crab apple." (*Meyer.*)

20238. MALUS sp. **Crab apple.**

From San-tau-lin-tze. "(No. 583.) A very shrubby form of the wild crab apple." (*Meyer.*)

20239. AMYGDALUS PERSICA. **Peach.**

From Kirin. "(No. 584.) A pale colored, medium-sized peach. Kirin is the most northern locality where I have as yet found peaches." (*Meyer.*)

20240. PRUNUS sp. **Cherry.**

From Kirin. "(No. 585.) A large-fruited bush cherry. Chinese name *Ta ying taor*." (*Meyer.*)

20241. PRUNUS sp. **Plum.**

From Kirin. "(No. 586.) A medium-sized, red-fruited sweet plum." (*Meyer.*)

20242. SALIX sp. **Willow.**

From near Yi-ma-tchau. "(No. 588.) A willow with opposite leaves." (*Meyer.*)

20243. PYRUS SINENSIS. **Pear.**

From Tieling. "(No. 589.) A wild pear with drooping branches and edible fruit." (*Meyer.*)

20230 to 20288—Continued.

20244. PYRUS SINENSIS. **Pear.**

From Liaoyang. "(No. 590.) A round, medium-sized, soft pear of reddish color. Chinese name *Shuy hong hsiau li.*" (*Meyer.*)

20245. PYRUS SINENSIS. **Pear.**

From Liaoyang. "(No. 591.) The famous fragrant-water pear or *Hsiang suy li;* used by the Chinese both dried and fresh." (*Meyer.*)

20246. PYRUS SINENSIS. **Pear.**

From Liaoyang. "(No. 592.) A medium-sized, soft pear, called *Ping li.*" (*Meyer.*)

20247. PYRUS SINENSIS. **Pear.**

From Liaoyang. "(No. 593.) A very large-fruited pear of yellow color and with juicy, somewhat hard flesh. A little coarse, but may be excellent for canning purposes." (*Meyer.*)

20248. PYRUS SINENSIS. **Pear.**

From Liaoyang. "(No. 594.) A soft pear, called *Moa pan suan li.*" (*Meyer.*)

20249. CAREX sp. **Sedge.**

From San-tau-lin-tze. "(No. 599.) A very nice sedge. May be valuable for lawn and fodder purposes in dry, cold regions." (*Meyer.*)

20250. CAREX sp. **Sedge.**

From near San-tau-lin-tze. "(No. 600.) A semicoarse sedge." (*Meyer.*)

20251 to 20267. PYRUS SINENSIS. **Pear.**

A collection of pear cuttings from Manchuria. With each number the Chinese varietal name is given. From Kwang-ning. (Nos. 601 to 617.)

20251.

Ma ti huang li. (No. 601.)

20252.

Chin tse li. (No. 602.)

20253.

Hsiang suy li. (No. 603.)

20254.

Ping ding li. (No. 604.)

20255.

Ta ma li. (No. 605.)

20256.

Ya li. One of the best pears of north China. (No. 606.)

20257.

Hung li. (No. 607.)

20258.

Chin pai li. (No. 608.)

20259.

Yuan po li. (No. 609.)

20260.

Mien swan li. (No. 610.)

20261.

Mien kuan li. (No. 611.)

20262.

An li. (No. 612.)

20263.

Kuan hung hsiao li. Seems to be a very rare variety; used only as presents to the Emperor. (No. 613.)

20264.

Chang poa li. (No. 614.)

20265.

Yu chiu li. (No. 615.)

20266

Ta li. (No. 616.)

20267.

Shan li hung. A wild mountain pear used as grafting stock. (No. 617.)

20230 to 20288—Continued.

20268. CRATAEGUS PINNATIFIDA. **Hawthorn.**

From Kwang-ning. "(No. 618.) A large-fruited hawthorn called *Tsuan dsao.*" (*Meyer.*)

20269 to 20275. PYRUS SINENSIS. **Pear.**

From Kwang-ning. (Nos. 619 to 625.)

20269.

Ne o tau li. (No. 619.)

20270.

Ta yang li. (No. 620.)

20271.

Huang hsiang sui li. (No. 621.)

20272.

Tang li. (No. 622.)

20273.

Ghua kai li. (No. 623.)

20274.

Lin yuen li. (No. 624.)

20275.

Nai tsu hsiang li. (No. 625.)

20276 to 20280. MALUS sp. **Apple.**

From Kwang-ning. (Nos. 626 to 630.)

20277.

Pin tsu. (No. 627.)

20278.

Hua hong chintze. A pretty flowering tree or shrub. (No. 628.)

20279.

Hua hong. A pretty flowering tree or shrub, a little different from the preceding. (No. 629.)

20280.

Ping kua. (No. 630.)

20281. PRUNUS sp. **Plum.**

From Kwang-ning. (No. 631.)

20282. AMYGDALUS PERSICA LAEVIS. **Nectarine.**

From Kwang-ning. (No. 634.)

Li tsu.

20283 to 20286. AMYGDALUS PERSICA. **Peach.**

From Kwang-ning. (Nos. 640 to 643.)

Ta hsing mei.

20283.

Ta chich tau. (No. 640.)

20284.

Pai tau. (No. 641).

20285.

Hung tau. (No. 642.)

20286.

Mao tau. (No. 643.)

20287 and 20288. PRUNUS sp. **Cherry.**

From Kwang-ning. (Nos. 644 and 645.)

20287.

Ta ying tao. (No. 644.)

20288.

Moa ying tao. (No. 645.)

20289 to 20424.

From Siberia. Received through Mr. Frank N. Meyer, agricultural explorer, February 28, 1907.

A collection of seeds, as follows:

20289. JUGLANS MANDSHURICA. **Manchuria walnut.**

From between Vladivostok and Spask. "(No. 515a, Oct. 19, 1906.) Collected from different trees in eastern Siberia. These are worthless from a utilitarian point of view, but the trees are quite ornamental and reach large sizes." (*Meyer.*)

20289 to 20424—Continued.

20290. TILIA CORDATA (?). **Linden.**

From Khabarovsk. "(No. 516a, Nov. 10 and 12, 1906.) A small-leaved linden growing wild in the neighborhood of Khabarovsk; is used in the city as an avenue tree; also in the parks and gardens. Seems to be a most profuse bloomer; height, 12 to 20 feet." (*Meyer.*)

20291. TILIA CORDATA (?). **Linden.**

From the mountains near Czernigowka. "(No. 517a, Oct. 22, 1906.) A small-leaved linden used locally for making wooden pumps and small water troughs. Apparently the same as No. 516a (S. P. I. No. 20290)." (*Meyer.*)

20292. TILIA MANDSHURICA (?). **Linden.**

From the mountains near Merkoechofka. "(No. 518a, Oct. 20, 1906.) A very large-leaved linden found growing in the forests; is used locally to make water troughs, barrels, and beehives. May be used in the colder parts of the United States as an ornamental park and shade tree." (*Meyer.*)

20293. TILIA MANDSHURICA. **Linden.**

From Khabarovsk. "(No. 519a, Nov. 7, 1906). Received from the forester of the Imperial Domains. This is said to be an ornamental forest tree." (*Meyer.*)

20294. ACER GINNALA. **Japan maple.**

From between Vladivostok and Iman. "(No. 520a, Oct., 1906.) The same as No. 424a (S. P. I. No. 20149)." (*Meyer.*)

20295. ACER PALMATUM. **Maple.**

From near Vladivostok. "(No. 521a, Oct. 6, 1906.) A medium-sized maple, the leaves of which assume a beautiful fiery-red color in the fall." (*Meyer.*)

20296. ACER sp. **Maple.**

From Saponsky. "(No. 522a, Oct. 19, 1906.) A bushy maple producing many stems, with a beautiful red-colored bark. Seed obtained from the forester of the government nursery at Saponsky." (*Meyer.*)

20297. ACER sp. **Maple.**

From the mountains near Merkoechofka. "(No. 523a, Oct. 25, 1906.) A bushy, red-stemmed maple, the same as No. 522a (S. P. I. No. 20296), but obtained from another source." (*Meyer.*)

20298. ACER MONO (?). **Maple.**

From Saponsky. "(No. 524a, Oct. 19, 1906.) A small or medium sized maple bearing a great profusion of small, five-pointed leaves, which assume a golden yellow color in the fall. Obtained from the forester of the government nursery at Saponsky." (*Meyer.*)

20299. ACER TEGMENTOSUM (?). **Maple.**

From Saponsky. "(No. 525a, Oct. 19, 1906.) A broad-leaved maple growing to be a small tree or large shrub. Obtained from the forester of the government nursery at Saponsky." (*Meyer.*)

20300. ACER TEGMENTOSUM. **Maple.**

From Khabarovsk. "(No. 526a, Nov. 7, 1906.) For description see No. 525a (S. P. I. No. 20299). Seed obtained from the forester of the Imperial Domains." (*Meyer.*)

20301. ACER sp. **Maple.**

From Khabarovsk. "(No. 527a, Nov. 7, 1906.) A small-sized maple of use as an ornamental bush in large shrubberies in parks. Obtained from the forester of the Imperial Domains." (*Meyer.*)

20289 to 20424—Continued.

30302. Corylus avellana. **Hazelnut.**

From Khabarovsk. "(No. 528a, Nov. 15, 1906.) Nuts purchased at a Chinese fruit stand in Khabarovsk; said to have come from Siberia." (*Meyer.*)

20303. Corylus rostrata. **Hazelnut.**

From Merkoechofka. "(No. 529a, Oct. 25, 1906.) A hazelnut growing on the edges of the forests, often covering very large expanses and forming dense thickets." (*Meyer.*)

20304. Corylus rostrata. **Hazelnut.**

From Khabarovsk. "(No. 530a, Nov. 15, 1906.) Purchased at a Chinese fruit stand in Khabarovsk; said to have come from the country along the Sungari." (*Meyer.*)

20305. Corylus rostrata. **Hazelnut.**

From Khabarovsk. "(No. 531a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains. For other remarks, see No. 520a (S. P. I. No. 20303)." (*Meyer.*)

20306. Quercus mongolica. **Oak.**

From between Vladivostok and Iman. "(No. 532a, Oct., 1906.) A rather large leaved oak found growing all over the country. May thrive in the coldest parts of the United States." (*Meyer.*)

20307. Quercus mongolica. **Oak.**

From Khabarovsk. "(No. 533a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains. For further description see No. 532a (S. P. I. No. 20306)." (*Meyer.*)

20308. Acanthopanax sessiliflorum.

From between Vladivostok and Spask. "(No. 534, Oct., 1906.) An ornamental, hardy shrub. For further description see Nos. 547 to 550 (S. P. I. No. 19476)." (*Meyer.*)

20309. Eleutherococcus senticosus.

From near Vladivostok and Merkoechofka. "(No. 535a, Oct., 1906.) A very spiny shrub, bearing palmate divided leaves and having at the end of its long shoots small umbels of black berries; grows generally in dense shade. May be of use as an undergrowth beneath tall trees." (*Meyer.*)

20310. Aralia mandshurica. **Chinese angelica tree.**

From the forest near Merkoechofka. "(No. 536a, Oct. 25, 1906.) A robust-growing Aralia, with very large leaves and bearing big umbels of whitish flowers." (*Meyer.*)

20311. Aralia mandshurica. **Chinese angelica tree.**

From Khabarovsk. "(No. 537a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains. For further remarks see No. 536a (S. P. I. No. 20310)." (*Meyer.*)

20312. Acanthopanax ricinifolium.

From the forest near Merkoechofka. "(No. 538a, Oct. 25, 1906.) A beautiful tree of striking appearance, having large, palmately lobed leaves and flowers in white umbels. A tree in full flower makes a striking impression, growing to be about 50 feet tall." (*Meyer.*)

20313. Picea sp. **Spruce.**

From the forest near Bo-tau-shan, northern Korea. (No. 539a, Aug. 24, 1906.)

20289 to 20424—Continued.

20314. Picea sp. **Spruce.**

From the primeval forests of Bo-tau-shan, northern Korea. "(No. 540a, Aug. 24, 1906.) A tall, large spruce." (*Meyer.*)

20315. Pinus koraiensis. **Pine.**

From Khabarovsk and Corvuskaya. "(Nos. 542a and 682a.) No. 542a was purchased at a Chinese fruit stand in the market at Khabarovsk, while No. 682a was obtained from collectors at Corvuskaya, where there are large forests of these pines." (*Meyer.*)

20316. Pinus koraiensis. **Pine.**

From Khabarovsk. "(No. 543a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20317. Pinus cembra. **Pine.**

From Khabarovsk. "(No. 544a, Nov. 15, 1906.) Edible pine seeds, said to have came from the forests of eastern Siberia; purchased at a Chinese fruit stand in the market at Khabarovsk." (*Meyer.*)

20318. Picea ajanensis. **Spruce.**

From Khabarovsk. "(No. 545a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20319. Picea obovata. **Spruce.**

From Khabarovsk. "(No. 546a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20320. Abies sibirica. **Fir.**

From Khabarovsk. "(No. 547a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20321. Larix dahurica. **Larch.**

From Khabarovsk. "(No. 548a, Nov. 7, 1907.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20322. Cladrastis amurensis.

From between Vladivostok and Iman. "(No. 549a, Oct., 1906.) A hardy, ornamental tree; seen often also as a shrub. Has beautiful hard wood, which is very durable and which can be used for many purposes, such as making furniture, bridge rafters, fence posts, etc. This tree is a slow grower." (*Meyer.*)

20323. Cladrastis amurensis.

From Khabarovsk. "(No. 550a, Nov. 14, 1906.) The same as No. 549a (S. P. I. No. 20322), but may be hardier" (*Meyer.*)

20324. Syringa amurensis. **Amur lilac.**

From Nikolsk. "(No. 552a, Oct. 18, 1906.) The beautiful Amur lilac, a vigorous-growing shrub, able to withstand great droughts and cold; having large, glossy, dark green leaves, and bearing large panicles of white flowers." (*Meyer.*)

20325. Fraxinus mandshurica. **Ash.**

From Khabarovsk. "(Nos. 553a and 554a, Nov. 12, 1906.) A tall-growing ash with rather large leaves; able to withstand much drought and cold. Obtained from the forester of the Imperial Domains." (*Meyer.*)

20326. Phellodendron amurense. **Chinese cork tree.**

From Sedansk. "(No. 555a, Oct. 6, 1906.) The Manchurian cork tree or, in Russian, *Barchat*. The wood is quite durable and takes on a beautiful polish; the berries contain a fragrant oil." (*Meyer.*)

20289 to 20424—Continued.

20327. PHELLODENDRON AMURENSE. **Chinese cork tree.**

From Khabarovsk. "(Nos. 556a and 668a, Nov. 7, 1906, and Apr. 11, 1907.) Obtained from the forester of the Imperial Domains. Coming from a more northern locality these seeds may produce hardier trees than those sent under No. 555a (S. P. I. No. 20326)." (*Meyer.*)

20328. CRATAEGUS SANGUINEA. **Hawthorn.**

From the mountains near Okiansk. "(No. 557a, Oct. 9, 1906.) A very hardy hawthorn growing all over eastern Siberia. Seeds also collected in northern Korea and sent under No. 380a (S. P. I. No. 20105)." (*Meyer.*)

20329. BERBERIS AMURENSIS. **Barberry.**

From Khabarovsk. "(No. 558a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains." (*Meyer.*)

20330. BERBERIS sp. **Barberry.**

From near Vladivostok. "(No. 559a, Oct. 5, 1906.) A shrub with large, light green leaves and large racemes of scarlet berries." (*Meyer.*)

(See also S. P. I. Nos. 20111 and 20112.)

20331. LONICERA sp. **Honeysuckle.**

From near Merkoechofka. "(No. 560a, Oct. 23, 1906.) A tall bush bearing red berries, growing in semishady places." (*Meyer.*)

20332. PHILADELPHUS sp. **Mock orange.**

From the mountains near Merkoechofka. "(No. 561a, Oct. 24, 1906.) A mock orange growing to be a very tall bush. Judging by the many fruit capsules on a bush, it must be a fine bush when in full bloom." (*Meyer.*)

20333. EUONYMUS THUNBERGIANUS.

From near Vladivostok. "(No. 562a, Oct. 6, 1906.) A low, bushy Euonymus having large, corky wings on its branches. When loaded with its numerous scarlet berries it is really quite ornamental." (*Meyer.*)

20334. EUONYMUS sp.

From near Vladivostok. "(No. 563a, Oct. 6, 1906.) A tall, bushy Euonymus with large, dark green leaves and bearing big red capsules." (*Meyer.*)

20335. LESPEDEZA sp.

From the mountains near Czernigowka. "(No. 564a, Oct. 21 and 22 1906.) A tall, shrubby Lespedeza bearing slender racemes or rosy flowers. Seems to be a good plant for rather dry situations." (*Meyer.*)

20336. PYRUS SINENSIS. **Pear.**

From Saponsky. "(No. 565a, Oct. 19, 1906.) *Pyrus ussuriensis.* The wild pear found growing all over eastern Siberia; produces worthless fruit, but may, on account of its hardiness, be utilized as a stock plant for better varieties, and also be used for hybridizing so as to extend the belt of pear culture farther north. Obtained from the forester of the government nursery at Saponsky." (*Meyer.*)

20337. PYRUS SINENSIS. **Pear.**

From Khabarovsk. "(No. 566a, Nov. 7, 1906.) *Pyrus ussuriensis.* Obtained from the forester of the Imperial Domains at Kharbarovsk. For description see preceding number." (*Meyer.*)

20338. PYRUS SINENSIS. **Pear.**

From Vladivostok. "(No. 567a, Oct. 6, 1906.) Seed of a large, juicy, brown pear said to have come from Japan." (*Meyer.*)

20289 to 20424—Continued.

20339. MALUS BACCATA. **Siberian crab apple.**

From near Okiansk. "(No. 568a, Oct. 9, 1906.) The ordinary type of *Malus baccata*, seen all over eastern Siberia, northern Korea, and Manchuria. Is worthless from a fruiting point of view, but may be very valuable as a stock for apples in the northern regions; also in hybridizing with large-fruited varieties it may be possible to produce a perfectly hardy apple far north. At the present, as an ornamental early-flowering shrub or tree it has most value." (*Meyer.*)

20340. MALUS BACCATA. **Siberian crab apple.**

From near Saponsky. "(No. 569a, Oct. 19, 1906.) Obtained from the forester of the government nursery at Saponsky. See also 568a (S. P. I. No. 20339)." (*Meyer.*)

20341. MALUS BACCATA. **Siberian crab apple.**

From Khabarovsk. "(No. 570a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains at Khabarovsk. For other remarks see 568a and 569a (S. P. I. Nos. 20339 and 20340)." (*Meyer.*)

20342. PRUNUS PUMILA. **Sand cherry.**

From Khabarovsk. "(No. 571a, Nov. 7, 1906.) A low bush bearing many scarlet cherries, which are generally inedible. Obtained from the forester of the Imperial Domains. Seeds of this cherry were also collected in Korea under Nos. 353a to 356a (S. P. I. Nos. 20085 to 20088)." (*Meyer.*)

20343. PRUNUS sp. **Plum.**

From Khabarovsk. "(No. 572a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains at Khabarovsk. May be of use as a stock plant or for breeding purposes." (*Meyer.*)

20344. PRUNUS GLANDULIFOLIA. **Chokecherry.**

From Khabarovsk. "(No. 573a, Nov. 7, 1906.) An ornamental chokecherry well adapted for use as a small avenue tree. Seems to be the same as that sent from Korea under No. 348a (S. P. I. No. 20080). Obtained from the forester of the Imperial Domains at Khabarovsk." (*Meyer.*)

20345. RUBUS sp. **Blackberry.**

From near Vladivostok. "For description see No. 358a. (S. P. I. No. 20196)." (*Meyer.*)

20346. DIOSPYROS KAKI. **Persimmon.**

From Khabarovsk. "(No. 575a, Nov. 14, 1906.) Seeds of a persimmon sold in Khabarovsk by Chinese fruit peddlers, coming from Chefoo, China." (*Meyer.*)

20347. VITIS AMURENSIS. **Grape.**

From Khabarovsk. "(No. 567a, Nov. 7, 1906.) Obtained from the forester of the Imperial Domains at Kharbarovsk. For other remarks see Nos. 551 and 552 (S. P. I. No. 19477) and 564 and 565 (S. P. I. No. 19600)." (*Meyer.*)

20348. VITIS AMURENSIS. **Grape.**

From between Vladivostok and Spask. "(No. 577a, Oct., 1906.) Seed of wild grapes collected at different points in eastern Siberia. See No. 567a (S. P. I. No. 20347)." (*Meyer.*)

20349. VITIS AMURENSIS. **Grape.**

From the mountains near Czernigowka. "(No. 578a, Oct. 23, 1906.) A very large leaved variety. For description see Nos. 564 and 565 (S. P. I. No. 19600)." (*Meyer.*)

20289 to 20424—Continued.

20350. Crataegus pinnatifida. **Hawthorn.**

From near Czernigowka. "(No. 579a, Oct. 23, 1906.) For description see No. 384a (S. P. I. No. 20109)." (*Meyer.*)

20351. Rosa sp. **Rose.**

From near Okiansk. "(No. 580a, Oct. 9, 1906.) A wild climbing rose." (*Meyer.*)

20352. Rosa sp. **Rose.**

From near Vladivostok. "(No. 581a, Oct. 6, 1906.) A wild rose forming a low, dense bush; of use as a shrub for small gardens." (*Meyer.*)

20353. Rosa rugosa. **Rose.**

From near Okiansk. "(No. 582a, Oct. 9, 1906.) A very low growing variety of the Japanese rose; of use in small gardens as an ornamental shrub." (*Meyer.*)

20354. Rosa sp. **Rose.**

From near Czernigowka. "(No. 583a, Oct. 23, 1906.) A wild rose forming low bushes and covering here and there large areas; of use in parks and gardens as a shrub for the borders." (*Meyer.*)

20355. Lilium sp. **Lily.**

From near Vladivostok. "(No. 584a, Oct. 6, 1906.) Seed of a wild lily found growing between shrubs; not seen in flower, but probably has scarlet blossoms." (*Meyer.*)

20356. Lilium sp. **Lily.**

From the mountains near Czernigowka. "(No. 585a, Oct. 21, 1906.) A lily with very narrow leaves; not seen in flower, but probably has pink blossoms." (*Meyer.*)

20357. Asparagus sp. **Asparagus.**

From near Sedansk. "(No. 586a, Oct. 8, 1906.) An ornamental asparagus, seeds of which were collected in northern Korea and sent under No. 433a (S. P. I. No. 20158)." (*Meyer.*)

20358. Actaea sp.(?).

From the forest near Merkoechofka. "(No. 587a, Oct. 24, 1906.) A perennial bearing blue berries and found growing in dense, shady places." (*Meyer.*)

20359. (Undetermined.)

From Tchien-shan mountains, southern Manchuria. "(No. 588a, June 8, 1906.) A perennial with several short stems, each bearing four dark green, serrated leaves of ovate-lanceolate form. Has long, narrow pods containing many small greenish seeds and is closely related to the Papaveraceæ and Fumariaceæ. It is only to be found in dense, shady places." (*Meyer.*)

20360. Actinidia kolomikta.

From the mountains near Merkoechofka. "(No. 589a, Oct. 24, 1906.) These fruits are called *Kishmis* by the Russian settlers here and are collected in the fall and can be kept, when dried, through the whole winter. They are used in bread and confectionery by the country people. See also No. 359a (S. P. I. No. 20197)." (*Meyer.*)

20361. Schizandra chinensis.

From near Vladivostok. "(No. 590a, Oct. 8, 1906.) For description see Nos. 360a, 567, and 568. (S. P. I. No. 19602.)" (*Meyer.*)

20289 to 20424—Continued.

20362. CLEMATIS sp. **Clematis.**

From Sedansk. "(No. 591a, Oct. 8, 1906.) A climbing Clematis; not seen in flower, but probably has yellow blossoms." (*Meyer.*)

20363. PANICUM CRUS-GALLI. **Barnyard millet.**

From Merkoechofka. "(No. 592a, Oct. 26, 1906.) Chinese name *Bay tze.* This millet prefers a heavy, wet soil; of use as a fodder plant. See also No. 50a (S. P. I. No. 17901)." (*Meyer.*)

20364. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 594a, Nov. 8, 1906.) *Black French.* '*Prolifique.*' Seed obtained from Mr. V. T. Kovaleff, in charge of the agricultural station at Khabarovsk. These oats were ordered from Russia in 1900 and gave in four years' time the heaviest crop of all oats experimented with up here." (*Meyer.*)

20365. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 595a, Nov. 8, 1906.) *Shatilovsky.* Obtained from Mr. V. T. Kovaleff, in charge of the agricultural station at Khabarovsk. These oats were ordered from Russia in 1905 and gave a heavy crop last year." (*Meyer.*)

20366. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 596a, Nov. 15, 1906.) *Shatilovsky.* Purchased on the market at Khabarovsk, where these oats are considered the best variety and are dearer than other varieties." (*Meyer.*)

20367. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 597a, Nov. 8, 1906.) *Shawannie.* Obtained from Mr. V. T. Kovaleff, in charge of the agricultural station at Khabarovsk. Original seed secured in Russia in 1900; produced rather good crops at Khabarovsk." (*Meyer.*)

20368. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 598a, Nov. 8, 1906.) A local variety of oats secured from Mr. V. T. Kovaleff, in charge of the agricultural station. This does not produce as heavy a crop as the improved varieties do." (*Meyer.*)

20369. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 599a, Nov. 15, 1906.) Purchased on the market at Khabarovsk. An ordinary variety grown anywhere." (*Meyer.*)

20370. AVENA SATIVA. **Oat.**

From Khabarovsk. "(No. 600a, Nov. 15, 1906.) Red oats purchased on the market at Khabarovsk; considered to be of a medium good quality." (*Meyer.*)

20371. TRITICUM VULGARE. **Wheat.**

From Khabarovsk. "(No. 601a, Nov. 8, 1906.) Summer wheat obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. This wheat has to be sown somewhat early here; otherwise it produces very little." (*Meyer.*)

20372. TRITICUM VULGARE. **Wheat.**

From Khabarovsk. "(No. 602a, Nov. 15, 1906.) Red summer wheat purchased on the market at Khabarovsk; grown locally and in Manchuria." (*Meyer.*)

20289 to 20424—Continued.

20373. Secale cereale. **Rye.**

From Khabarovsk. "(No. 603a, Nov. 8, 1906.) *Propsteyer.* Winter rye obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. Original seed secured in Russia in 1895. When sown the last week in August it produces in general a satisfactory crop." (*Meyer.*)

20374. Secale cereale. **Rye.**

From Khabarovsk. "(No. 604a, Nov. 8, 1906.) *Propsteyer.* Summer rye obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. Original seed secured in Russia in 1897; does not produce as heavy a crop as the winter rye." (*Meyer.*)

20375. Hordeum hexastichum. **Six-row barley.**

From Khabarovsk. "(No. 605a, Nov. 6, 1906.) Obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. This barley produces medium heavy crops here." (*Meyer.*)

20376. Fagopyrum esculentum. **Buckwheat.**

From Khabarovsk. "(Nos. 606a and 674a, Nov. 8, 1906.) A local variety of buckwheat obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. This variety is not a very great success here." (*Meyer.*)

20377. Helianthus annuus. **Sunflower.**

From Merkoechofka. "(No. 607a, Oct. 25, 1906.) A local form of sunflower producing many heads." (*Meyer.*)

20378. Brassica napus. **Rape.**

From Khabarovsk. "(No. 609a, Nov. 8, 1906.) Summer rape obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. Original seed secured in Russia in 1902." (*Meyer.*)

20379. Sinapis alba. **White mustard.**

From Khabarovsk. "(No. 610a, Nov. 8, 1906.) Obtained from Mr. V. T. Kovaleff, in charge of the agricultural station. Original seed secured in Russia in 1902." (*Meyer.*)

20380. Pisum sativum. **Pea.**

From Khabarovsk. "(No. 611a, Nov. 8, 1906.) Wax peas obtained from Mr. V. T. Kovaleff, in charge of agricultural station. Original seed secured in Russia in 1900; not a very good producer in this country." (*Meyer.*)

20381. Pisum sativum. **Pea.**

From Khabarovsk. "(No. 612a, Nov. 8, 1906.) An early green pea obtained from Mr. V. T. Kovaleff, in charge of agricultural station. Original seed secured in Russia in 1900; a rather good producer at Khabarovsk." (*Meyer.*)

20382. Pisum sativum. **Pea.**

From Khabarovsk. "(No. 613a, Nov. 8, 1906.) A local variety of white peas secured from Mr. V. T. Kovaleff, in charge of agricultural station. This variety is the largest producer in these regions." (*Meyer.*)

20383. Lathyrus maritimus.

From the shore of Amur Bay, near Sedansk. "(No. 614a, Oct. 6, 1906.) A perennial pea." (*Meyer.*)

20384. Trifolium sp. **Clover.**

From the mountains near Czernigowka. "(No. 615a, Oct. 22, 1906.) For description see 328a and 329a (S. P. I. Nos. 20021 and 20022.)" (*Meyer.*)

20289 to 20424—Continued.

20385. VICIA sp. **Vetch.**

From the mountains near Czernigowka. (No. 616a, Oct. 21, 1906.)

20386. AMPHICARPAEA EDGWORTHII (?).

From the mountains near Czernigowka. (No. 617a, Oct. 22, 1906.)

20387. SCIRPUS LACUSTRIS.

From near Sedansk. "(No. 618a, Oct. 7, 1906.) Found growing in standing water on clayey land. May be of use for making coarse, cheap matting. Sow the seeds in pans which are kept in standing water." (*Meyer.*)

20388. JUNCUS EFFUSUS (?). **Rush.**

From near Czernigowka. "(No. 620a, Oct. 22, 1906.) A rush, found growing in moist mountain meadows on black, peaty soil. This is a valuable rush for matting manufacture. See Nos. 559 and 560 (S. P. I. No. 19597)." (*Meyer.*)

20389. JUNCUS sp. (?).

From near Vladivostok. "(No. 624a, Oct. 5, 1906.) A juncus-like plant growing in swampy, submerged places." (*Meyer.*)

20390. ELYMUS SABULOSUS.

From the shore of Amur Bay, Sedansk. "(No. 626a, Oct. 7, 1906.) A grass which may be of use as a sand binder in the northern parts of the United States." (*Meyer.*)

20391. CALAMAGROSTIS sp.

From the mountains near Czernigowka. "(No. 627a, Oct. 22, 1906.) A tall, slender grass, growing in dense masses in the open forest. It is browsed upon by cattle and may be of use as a forage grass in the colder parts of the United States." (*Meyer.*)

20392. ARUNDINELLA ANOMALA.

From the mountains near Czernigowka. "(No. 629a, Oct. 21, 1906.) A coarse grass that may be of use as a forage grass in the colder, drier parts of the United States." (*Meyer.*)

20393. PANICULARIA sp.

From near Sedansk. "(No. 631a, Oct. 7, 1906.) A tall-growing variety of swamp-grass, to be tried as a fodder grass on swampy land." (*Meyer.*)

20394. PANICULARIA sp.

From near Sedansk. (No. 632, Oct. 7, 1906.) For description see S. P. I. No. 20393.

20395. ANDROPOGON sp.

From the mountains near Czernigowka. "(No. 633a, Oct. 22, 1906.) A grass found growing in the open forest on rather sterile soil." (*Meyer.*)

20396. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 634a, Nov. 15, 1906.) Large, red beans, purchased on the market at Khabarovsk. These beans are grown in Siberia for food, being eaten either fresh or dried. This is a dwarf variety, and seems to thrive best on black, peaty soil." (*Meyer.*)

20397. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 635a, Oct. 25, 1906.) Large, rosy beans, grown locally for food, being eaten either fresh or dried. A dwarf variety that seems to thrive best on black, peaty soil." (*Meyer.*)

20289 to 20424—Continued.

20398. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 636a, Oct. 25, 1906.) A yellow bean, grown locally for food." (*Meyer.*)

20399. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 637a, Oct. 25, 1906.) Medium-sized, dwarf, white beans, grown locally for food." (*Meyer.*)

20400. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 638a, Oct. 25, 1906.) Small, dwarf, white beans, grown locally for food." (*Meyer.*)

20401. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 639a, Oct. 25, 1906.) Very small, dwarf, white beans, grown locally for food." (*Meyer.*)

20402. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 640a, Nov. 15, 1906.) Small, yellowish beans, purchased in the market at Khabarovsk." (*Meyer.*)

20403. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 641a, Nov. 15, 1906.) Small, blackish beans, purchased in the market at Khabarovsk." (*Meyer.*)

20404. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 642a, Nov. 15, 1906.) Small, red beans, purchased in the market at Khabarovsk." (*Meyer.*)

20405. GLYCINE HISPIDA. **Soy bean.**

From Khabarovsk. "(No. 643a, Nov. 15, 1906.) Round, yellow soy beans purchased in the market at Khabarovsk. The Chinese let these beans sprout and use the sprouts all winter as a vegetable. Oil is also extracted from this variety, and the cakes thus formed make a very nutritious food for horses." (*Meyer.*)

20406. GLYCINE HISPIDA. **Soy bean.**

From Khabarovsk. "(No. 644a, Nov. 15, 1906.) A yellow soy bean purchased in the market at Khabarovsk." (*Meyer.*)

20407. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 645a, Oct. 25, 1906.) A brown-black variety grown in eastern Siberia; does not scatter when ripe and is very late in ripening, as it is harvested in the last half of October. Is used for food, being boiled with millet. This variety seems to have come originally from more southern regions, as the season here is somewhat short for it." (*Meyer.*)

20408. GLYCINE HISPIDA. **Soy bean.**

From Khabarovsk. "(No. 647a, Nov. 8, 1906.) Black soy beans obtained from Mr. V. T. Kovaleff, in charge of the experiment station at Khabarovsk. These seeds came originally from Manchuria in 1899 and are ripening here to perfection, while the light and dark yellow varieties do not ripen well at all. Are used for food for domestic animals when boiled, and are also sometimes fed in the green state." (*Meyer.*)

20409. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 648a, Oct. 25, 1906.) Very small, brownish beans obtained from a farmer in Merkoechofka; said to have come originally from Manchuria." (*Meyer.*)

20289 to 20424—Continued.

20410. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 649a, Oct. 25, 1906.) Very small, black beans obtained from a farmer in Merkoechofka; said to have come originally from Manchuria." (*Meyer.*)

20411. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 650a, Oct. 25, 1906.) Very small, dull-black beans obtained from a farmer in Merkoechofka; said to have come originally from Manchuria." (*Meyer.*)

20412. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 651a, Oct. 25, 1906.) Brown soy beans found mixed with No. 645a (S. P. I. No. 20406)." (*Meyer.*)

20413. PHASEOLUS VULGARIS. **Bean.**

From Merkoechofka. "(No. 652a, Oct. 25, 1906.) Black beans." (*Meyer.*)

20414. GLYCINE HISPIDA. **Soy bean.**

From Merkoechofka. "(No. 653a, Oct. 25, 1906.) Small, black soy beans obtained from a farmer in Merkoechofka; said to have come originally from Manchuria." (*Meyer.*)

20415. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 654a, Nov. 15, 1906.) Red beans found mixed with No. 634a (S. P. I. No. 20396), and seem to be a variety of that number." (*Meyer.*)

20416. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 655a, No. 15, 1906.) Brown beans found mixed with No. 634a (S. P. I. No. 20396), and seem to be a variety of that number." (*Meyer.*)

20417. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 656a, Nov. 15, 1906.) Dark brown-red beans found mixed with No. 634a (S. P. I. No. 20396)." (*Meyer.*)

20418. TYPHA LAXMANNI. **Cat-tail.**

From near Vladivostok. "(No. 664a, Oct. 5, 1906.) A very diminutive *Typha* especially adapted for a small pond in a Japanese garden. Should be sown on sterilized, peaty soil and the seed vessel kept in a saucer of water with a glass plate over the top." (*Meyer.*)

20419. NYMPUAEA sp. **Pond lily.**

From Lake Hanka. "(No. 665a, Oct. 29, 1906.) A water lily found growing in Lake Hanka; probably not ornamental." (*Meyer.*)

20420. RHEUM RHAPONTICUM. **Rhubarb.**

From Khabarovsk. "(No. 669a, Nov. 20, 1906.) A rhubarb perfectly hardy in this climate, where the temperature drops to 45° F. below zero in midwinter. Obtained from the agricultural station at Khabarovsk." (*Meyer.*)

20421. PHASEOLUS VULGARIS. **Bean.**

From Khabarovsk. "(No. 670a, Nov. 20, 1906.) A large, climbing bean obtained from the agricultural station at Khabarovsk. This bean is eaten as a vegetable when fresh, the pods being sliced." (*Meyer.*)

20289 to 20424—Continued.

20422. Papaver somniferum. **Opium poppy.**

From Khabarovsk. "(No. 671a, Nov. 20, 1906.) Seed of a white poppy obtained from the agricultural station at Khabarovsk. This poppy is used locally by the Russians as a condiment on cakes and for oil production, and by the Chinese for opium production." (*Meyer.*)

20423. Papaver somniferum **Opium poppy.**

From Khabarovsk. "(No. 672a, Nov. 20, 1906.) Seed of a blue poppy obtained from the agricultural station at Khabarovsk. For description see No. 671a (S. P. I. No. 20422)." (*Meyer.*)

20424. Avena sativa. **Oat.**

From Khabarovsk. "(No. 673a, Nov. 20, 1906.) *Black French.* '*Prolifique.*' Obtained from the agricultural station at Khabarovsk. These oats are the best variety that has been experimented with in these northern regions and are considered by the manager of the station as very good." (*Meyer.*) (Same as S. P. I. No. 20364.)

20425. Medicago sativa. **Alfalfa.**

From Liaoyang, Manchuria. Received through Mr. Frank N. Meyer, agricultural explorer, February 28, 1907.

"(No. 721a, Jan. 26, 1907.) An alfalfa growing in a sterile and rather exposed situation on the city wall of Liaoyang; possibly of value for the northern arid regions of the United States. Does not produce much growth in Liaoyang, but may develop when placed in a better situation." (*Meyer.*)

20426 to 20431.

From Paris, France. Presented by Prof. Julien Constantin, of the Museum of Natural History. Received March 16, 1907.

Roots, as follows:

20426. Coleus dazo.

Dazo.

20427. Coleus tuberosus.

20428. Plectranthus coppini.

20429. Plectranthus coppini.

Variety *nigra.*

20430. Plectranthus coppini.

Variety *rubra.*

20431. Plectranthus ternatus.

20435. Sechium edule. **Chayote.**

From Funchal, Madeira. Received through Mr. David Fairchild, March 19, 1907.

A lot containing large, smooth, and small prickly fruits.

20436. (Undetermined.) **"Umshakata."**

From Gwelo, South Africa. Presented by Mr. W. M. Longden, of Melsetter. Received March 25, 1907.

"A fruit very common in the low-lying parts of the district, known by the natives as *Umshakata.* This tree grows in many parts of this district, but attains a great size only in very warm, low-lying parts, and does not seem to fruit at all in places where there is much frost. This fruit is from the farm of Mr. R. A. Blake, of Gwelo." (*Longden.*)

20438 to 20440.

From Kelso, Scotland. Received through Laing and Mather, March 23, 1907.

20438. Dactylis glomerata. **Orchard grass.**

Danish.

20438 to 20440—Continued.

20439. PHLEUM PRATENSE. **Timothy.**

Scotch.

20440. FESTUCA PRATENSIS. **Meadow fescue.**

Danish.

20447. DOLICHOS LABLAB. **Hyacinth bean.**

From Paris, France. Received through Vilmorin-Andrieux & Co., March 25, 1907.

Stringless variety.

20450. XANTHOSOMA sp. **Yautia.**

From the Isle of Pines. Presented by Dr. S. W. Mellott, of Santa Fe. Received March 26, 1907.

"Roots of what is said to be the best variety of yautia grown in the Isle of Pines. This lot is from an English colony from Cayman Island, now settled on the south coast of the Isle of Pines." (*Mellott.*)

20451. XANTHOSOMA sp. **Yautia.**

From Victoria, Tamaulipas, Mexico. Presented by Dr. Edward Palmer. Received March 25, 1907.

"A very common plant here; it gets into the water ditches and is as hard to get rid of as Johnson grass; it is called *Rejolgar* and no use is made of it here." (*Palmer.*)

20453. AGAVE sp. **Zapupe.**

From Victoria, Tamaulipas, Mexico. Received through Mr. Bernardo Zodilla, March 27, 1907.

Bulbils.

20454. SCIRPUS sp. **Rush.**

From Caldas da Rainha, Portugal. Received through Mr. David Fairchild, March 27, 1907.

"(No. 020.) Seed of a rush called the wild rush, which, though longer and even taller at times than the slender variety (see S. P. I. No. 19998), is brittle and not used for tying the vines or for mat making." (*Fairchild.*)

20458 to 20483.

From Svalöf, Sweden. Received through the Allmänna Svenska Utsädesaktiebolaget, March 22, 1907.

20458. AVENA SATIVA. **Oat.**

Svalöfs Hvitlinghafre (White oats).

20459. AVENA SATIVA. **Oat.**

Svalöfs Ligowohafre (Ligowo oats).

20460. AVENA SATIVA. **Oat.**

Svalöfs Guldregnshafre (Golden Rain oats).

20461. AVENA SATIVA. **Oat.**

Svalöfs Borstlösa Propsteierhafre (awnless Propsteier oats.)

20462. AVENA SATIVA. **Oat.**

Svalöfs Hvita Propsteierhafre (White Propsteier oats).

20463. AVENA SATIVA. **Oat.**

Svalöfs Svarta Klockhafre (Black Bell oats).

20458 to 20483—Continued.

20464. Avena sativa. **Oat.**

Svalöfs Svarta Stormogulhafre (Black Great Mogul oats).

20465. Pisum sativum. **Pea.**

Svalöfs Kapitalärt (Capital).

20466. Pisum sativum. **Pea.**

Svalöfs Concordiaärt (Concordia).

20467. Pisum arvense. **Pea.**

Soloärt (Solo).

20468. Trifolium pratense. **Red clover.**

Gammal Svensk Rödklöfver (Old Swedish red clover).

20469. Phleum pratense. **Timothy.**

20470. Dactylis glomerata. **Orchard grass.**

Hundäxing (Couch-grass).

20471. Arrhenatherum elatius. **Tall oat-grass.**

Knylhafre (Tall oats).

20472. Festuca pratensis. **Meadow fescue.**

Angssvingel (Dansk.) (Danish meadow fescue).

20473. Festuca arundinacea. **Reed fescue.**

Rörsvingel (Reed fescue).

20474. Bromus inermis. **Smooth brome-grass.**

Foderlosta (Fodder brome-grass).

20475. Bromus erectus. **Erect brome-grass.**

Raklosla (Erect brome-grass).

20476. Poa pratensis. **Kentucky bluegrass.**

Angsgröe (Meadow reed).

20477. Holcus lanatus. **Velvet grass.**

Luddtätel (Velvet grass).

20478. Phalaris arundinacea. **Reed canary grass.**

Rörflen (Reed canary grass).

20479. Melilotus alba. **Sweet clover.**

Hvitmelot (White melilot).

20480. Hordeum distichum. **Two-row barley.**

Hannchen.

20481. Hordeum hexastichum. **Six-row barley.**

Vätte Sexradskorn.

20482. Hordeum distichum. **Two-row barley.**

0301 Gottland.

20483. Brassica rapa. **Turnip.**

Kålrötter (cabbage-root).

20484 to 20490. XANTHOSOMA spp. Yautia.

From Sanchez, Santo Domingo. Presented by Mr. A. Hyatt Verrill, through Mr. O. W. Barrett. Received March 30, 1907.

Seven apparently distinct varieties without further data.

20492. PITTOSPORUM PENTANDRUM.

From Manila, P. I. Presented by Mr. W. S. Lyon, of the Bureau of Agriculture, March 21, 1907.

"Seed of an evergreen shrub, very showy when in fruit. Found in the Zambales Mountains at an altitude of 300 to 600 feet." (*Lyon.*)

20493. (Undetermined.)

From Washington, D. C. Presented by Hon. Edward A. Moseley, secretary, Interstate Commerce Commission. Received April 1, 1907.

Hon-Qua. "Seed of a species of gourd-like melon which the Chinese use for preserve making and in soups. Mr. Moseley says that the seeds of this are characteristic, with a curious protuberance near the hilum. Chinese in this country pay 50 cents a pound for these melons. They are often kept for two or three years by the Chinese before using. The culture is the same as that given to watermelons. Flesh white and as firm as the part of a watermelon which is commonly preserved." (*Fairchild.*)

20495 to 20504. PHOENIX DACTYLIFERA. Date.

From Tempe, Ariz. Received through Mr. C. J. Brand during the winter of 1906–7.

Seeds from American-grown fruit of the following imported varieties:

20495. *Amari.* (P. L. H. No. 2066.)

20496. *Birket el Haggi.* (P. L. H. No. 2067.)

20497. *Deglet Noor.* (P. L. H. No. 2068.)

20498. *False Rhars.* (P. L. H. No. 2069.)

20499. *Hamraia.* (P. L. H. No. 2070.)

20500. *Kemp's Seedling.* (P. L. H. No. 2071.)

20501. (No name.) (P. L. H. No. 2072.)

20502. *Oga de Bedreschen.* (P. L. H. No. 2073.)

20503. *Purdy Seedling.* (P. L. H. No. 2074.)

20504. *Rhars.* (P. L. H. No. 2075.)

See remarks under next shipment.

20505 to 20507. PHOENIX DACTYLIFERA. Date.

From Tempe, Ariz. Received through Mr. F. H. Simmons, manager, Tempe Date Garden, March 10, 1907.

Seeds from American-grown fruit of the following varieties:

20505. *Deglet Noor.* (P. L. H. No. 2098.)

20506. *Rhars.* (P. L. H. No. 2099.)

20507. *Oga de Bedreschen.* (P. L. H. No. 2100.)

"Both lots, S. P. I. Nos. 20495 to 20507, were raised on imported offshoots grown in the Cooperative Date Garden in Tempe and were distributed with the expectation of securing some good varieties through seedlings." (*Brand.*)

20508 to 20514. Phoenix dactylifera. **Date.**

From Bagdad, Asiatic Turkey. Received through the Hills Brothers Company, of Bassorah, Arabia, and New York, N. Y., February 15, 1907.

A collection of date seeds, as follows:

20508.

Ascherasi. (See S. P. I. No. 8739.)

20509.

Bedraihe. (See S. P. I. No. 8740.)

20510.

Lehedi or *Zehedi.* (See S. P. I. No. 8743.)

20511.

Kustawi. (See S. P. I. No. 8738.)

20512.

Maktum. (See S. P. I. No. 8741.)

20513.

Sukeri. (See S. P. I. No. 8745.)

20514.

Yaberzal or *Taberzal.* (See S. P. I. No. 8794.)

20515 and 20516. Phoenix dactylifera. **Date.**

From Washington, D. C. Received through H. L. Strang & Co., March, 1907.

Two varieties of dates purchased in the open market.

20515.

Haluwi, from Bassorah, Arabia. (See S. P. I. No. 8750.)

20516.

Fard, from Mascat, Arabia. (See S. P. I. No. 8754.)

"Both lots, S. P. I. Nos. 20508 to 20516, inclusive, secured for the purpose of propagating seedlings in the expectation of securing some good varieties." (*Swingle.*)

20519. Musa livingstoniana.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, botanist, Transvaal Department of Agriculture. Received March 18, 1907.

"This is an East African wild banana, with seed fruits; probably a good ornamental." (*Barrett.*)

20521 to 20795.

From northern Europe, Siberia, and eastern Asia.

Seeds collected by Prof. N. E. Hansen, of the agricultural experiment station, Brookings, S. Dak., in 1906 while traveling as an agricultural explorer for the Department of Agriculture on an extended trip through Scandinavia, Russia, Siberia, and returning through China and Japan. Received March 1907.

20521. Trifolium pratense. **Red clover.**

From Lapland, Sweden. "(No. 1.) Wild red clover from Pajala; 1905 seed." (*Hansen.*)

20522. Trifolium pratense. **Red clover.**

From Lapland, Sweden. "(No. 2.) Native red clover from Karungi, about 40 kilometers north of Haparanda." (*Hansen.*)

20523. Trifolium pratense. **Red clover.**

From Lapland, Sweden. "(No. 3.) Wild red clover found in the vicinity of the experiment station in Luleå; the locality is termed Norrbotten. Seed from a different place from that of No. 6 (S. P. I. No. 20526)." (*Hansen.*)

20521 to 20795—Continued.

20524. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 4.) Native red clover from Pajala; 1906 seed." (*Hansen.*)

20525. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 5.) Seed collected by the experiment station at Luleå from an early, wild red clover in 1906." (*Hansen.*)

20526. TRIFOLIUM PRATENSE. **Red clover.**

From Luleå, Sweden. "(No. 6.) Wild red clover found in the vicinity of the experiment station in Luleå. Seed from a different place from that of No. 3 (S. P. I. No. 20523)." (*Hansen.*)

20527. TRIFOLIUM PRATENSE. **Red clover.**

From Luleå, Sweden. "(No. 7.) Seed collected in 1906 by the experiment station at Luleå from a single plant of the early wild red clover of that vicinity." (*Hansen.*)

20528. TRIFOLIUM PRATENSE. **Red clover.**

From Luleå, Lapland, Sweden. "(No. 8.) This sample is from seed of a single plant selected by the experiment station at Luleå in 1906. The original seed was secured at Pajala, Lapland, in 1901. The extreme northern limit of the wild red clover in Lapland appears to be Karesuando, about 68° 15′ N. lat., so that the present sample is from about 75 miles south of the extreme northern limit." (*Hansen.*)

20529. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 9.) Wild red clover from Kalle, about 62 miles north of Luleå." (*Hansen.*)

20530. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 10.) Sample of the late-flowering form of the Swedish red clover. Originally from southern Sweden, but the present sample is 1906 seed and the result of thirteen years of natural selection at Luleå." (*Hansen.*)

20531. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 11.) Seed collected in 1906 from a single plant of the local native red clover by the experiment station at Luleå." (*Hansen.*)

20532. TRIFOLIUM PRATENSE. **Red clover.**

From Lapland, Sweden. "(No. 12.) Sample of the wild red clover from Pajala; 1906 seed from the experiment station at Luleå." (*Hansen.*)

20533. TRIFOLIUM PRATENSE. **Red clover.**

From Bodoe, Norway. "(No. 13.) The wild red clover from Bodoe, latitude 67°. This is north of the Arctic Circle." (*Hansen.*)

20534. TRIFOLIUM REPENS. **White clover.**

From Lapland, Sweden. "(No. 14.) Seed gathered in 1906 by the experiment station at Luleå from the native white clover of that vicinity." (*Hansen.*)

20535. TRIFOLIUM HYBRIDUM. **Alsike clover.**

From Lapland, Sweden. "(No. 15.) Seed gathered in 1906 by the experiment station at Luleå from a single plant of the native alsike clover of that vicinity." (*Hansen.*)

20536. TRIFOLIUM REPENS. **White clover.**

From Lapland, Sweden. "(No. 16.) Seed of the wild white clover gathered in 1906 about 20 miles north of Haparanda." (*Hansen.*)

20521 to 20795—Continued.

20537. TRIFOLIUM HYBRIDUM. **Alsike clover.**

From Lapland, Sweden. "(No. 17.) Seed gathered in 1906 by the experiment station at Luleå from a single plant of wild alsike clover of that vicinity." (*Hansen.*)

20538. POA SEROTINA.

From Lapland, Sweden. "(No. 18.) Seed of a good native grass gathered in 1906 at Korpilombolo, about eighty-five miles north of Luleå." (*Hansen.*)

20539. POA SEROTINA L.

From Lapland, Sweden. "(No. 19.) Seed gathered from several plants in 1905 at Korpilombolo." (*Hansen.*)

20540. POA SEROTINA.

From Lapland, Sweden. "(No. 20.) Seed of a good native grass from Kalix, about 62 miles north of Luleå." (*Hansen.*)

20541. POA SEROTINA.

From Lapland, Sweden. "(No. 21.) Seed selected in 1906 from a single plant of the native form by the experiment station at Luleå." (*Hansen.*)

20542. POA SEROTINA.

From Lapland, Sweden. "(No. 22.) A good native grass from about 50 miles north of Luleå; gathered in 1905 by the experiment station at Luleå." (*Hansen.*)

20543. VICIA CRACCA. **Bird vetch.**

From Lapland, Sweden. "(No. 23.) An excellent forage plant, especially on poor soil. Seed gathered from a single plant of the native form in 1906 by the experiment station at Luleå." (*Hansen.*)

20544. PHLEUM PRATENSE. **Timothy.**

From Lapland, Sweden. "(No. 24.) Seed from several plants of the native timothy from southern or central Sweden. Grown at Luleå five years; seed gathered in 1906 by the experiment station at Luleå." (*Hansen.*)

20545. PHLEUM PRATENSE. **Timothy.**

From Lapland, Sweden. "(No. 25.) Seed selected from a single plant of the native timothy at Pilea, Norrbotten district, in 1906." (*Hansen.*)

20546. PHLEUM ALPINUM. **Mountain timothy.**

From Lapland, Sweden. "(No. 26.) Seed of the wild timothy from Qvickjock." (*Hansen.*)

20547. FESTUCA RUBRA. **Red fescue.**

From Lapland, Sweden. "(No. 27.) Seed of the wild form from Luleå; selected by the experiment station." (*Hansen.*)

20548. FESTUCA RUBRA. **Red fescue.**

From Lapland, Sweden. "(No. 28.) The same source as No. 27 (S. P. I. No. 20547), but a different selection." (*Hansen.*)

20549. FESTUCA ELATIOR. **Tall fescue.**

From Lapland, Sweden. "(No. 29.) A good native grass from Ranea, about 25 miles north of Luleå." (*Hansen.*)

20550. AGROSTIS ALBA. **Redtop.**

From Lapland, Sweden, "(No. 30.) Seed selected in 1905 by the experiment station at Luleå from wild plants in that vicinity." (*Hansen.*)

20521 to 20795—Continued.

20551. ALOPECURUS PRATENSIS. **Meadow foxtail.**

From Lapland, Sweden. "(No. 31.) A good native grass from Luleå." (*Hansen.*)

20552. ALOPECURUS NIGRICANS.

From Lapland, Sweden. "(No. 32.) A good native grass from Haparanda. This grass likes rich, moist soil full of humus. Selection from Luleå Experiment Station." (*Hansen.*)

20553. ALOPECURUS NIGRICANS.

From Lapland, Sweden. "(No. 33.) The same source as No. 32 (S. P. I. No. 20552) but another selection." (*Hansen.*)

20554. ALOPECURUS PRATENSIS.

From Lapland, Sweden. "(No. 34.) A valuable grass highly regarded as making hay of as good quality as timothy. Suitable for moist soils. The native form from Luleå. See No. 267 (S. P. I. No. 20787)." (*Hansen.*)

20555. ANTHYLLIS VULNERARIA.

From Lapland, Sweden. "(No. 35.) A good native leguminous forage plant from Luleå." (*Hansen.*)

20556. SECALE CEREALE. **Rye.**

From Yakutsk, Siberia. "(No. 36.) Spring rye from Yakutsk, 62° 30′ N. lat., 132° west of Greenwich. This is probably the most northern point where cereals are raised to any extent in Siberia. This seed is old, as it was brought from Yakutsk by a Swedish expedition in 1898–99 searching after André. Sample secured at the experiment station, Svalöf, southern Sweden." (*Hansen.*)

20557. HORDEUM VULGARE. **Barley.**

From Yakutsk, Siberia. "(No. 37.) Spring barley from the same source as No. 36 (S. P. I. No. 20556). This variety has done well at Svalöf and some new selections have been made from it." (*Hansen.*)

20558. TRITICUM VULGARE. **Wheat.**

From Yakutsk, Siberia. "(No. 38.) Spring wheat from the same source as No. 36 (S. P. I. No. 20556)." (*Hansen.*)

20559. AVENA SATIVA. **Oat.**

From Yakutsk, Siberia. "(No. 39.) Spring oats from the same source as No. 36 (S. P. I. No. 20556)." (*Hansen.*)

20560. AVENA SATIVA. **Oat.**

From Svalöf, Sweden. "(No. 40.) A pedigree variety of spring oats (Svalöf No. .0392) selected by the experiment station at Svalöf from oats originally received from Yakutsk, Siberia. See Nos. 36 and 39 (S. P. I. Nos. 20556 and 20559)." (*Hansen.*)

20561. AVENA SATIVA. **Oat.**

From Luleå, Lapland, Sweden. "(No. 41.) A pedigree variety of black oats selected from seed originally from Norrland, the Arctic Circle province of northern Norway. It is No. 11 of Luleå and No. .0668 of Svalöf. The present sample is from the experiment station at Luleå." (*Hansen.*)

20562. AVENA SATIVA. **Oat.**

From Luleå, Sweden. "(No. 42.) A low, dwarf variety originally from Switzerland. The present sample was grown in 1906 by the experiment station at Luleå." (*Hansen.*)

20521 to 20795—Continued.

20563. Avena sativa. **Oat.**

From Luleå, Sweden. "(No. 43.) A tall, fine variety of black oats, the best so far at the Svalöf Experiment Station. It is Svalöf No. .0660, originally from the native black oats of northern Finland. The present sample is No. 10 from the experiment station at Luleå." (*Hansen.*)

20564. Festuca elatior. **Tall fescue.**

From Ranea, Lapland, Sweden. "(No. 44.) An excellent grass both for sandy and clay soils; very productive of seed and responds quickly to manuring with potash and phosphate manures. Ranea is about 25 miles north of Luleå." (*Hansen.*)

20565. Vicia cracca. **Bird vetch.**

From the Ultuna district, 60° N. lat., Sweden. "(No. 45.) A good native leguminous forage plant." (*Hansen.*)

20566. Trifolium pratense. **Red clover.**

From the Norrland section, 64° N. lat., Sweden. (Hansen's No. 46.)

20567. Trifolium pratense. **Red clover.**

From Sweden. "(No. 47.) The Swedish red clover as grown for 20 years on the same farm in the Luleå district in 60° N. lat." (*Hansen.*)

20568. Triticum vulgare. **Wheat.**

From the experiment station at Ultuna, near Upsala, Sweden. "(No. 48.) *Svalöf's Extra Squarehead.* Winter wheat selected by the experiment station at Svalöf, southern Sweden." (*Hansen.*)

20569. Triticum vulgare. **Wheat.**

From Ultuna, near Upsala, Sweden. "(No. 49.) *Poodle.* A winter wheat originated by the experiment station at Svalöf. The name refers to the velvet chaff, being woolly like a French poodle." (*Hansen.*)

20570. Vicia sp. **Vetch.**

From Svalöf, Sweden. "(No. 50.) A good forage plant originated by the experiment station at Svalöf; season early. Svalöf No. .0151." (*Hansen.*)

20571. Medicago media. **Sand lucern.**

From Ultuna, near Upsala, Sweden. "(No. 51.) Native alfalfa taken from 20-year-old fields near Ultuna, about 60° N. lat. Possibly there is some *Medicago falcata* mixed with it, as both are found in this vicinity. A promising forage plant for cold, rather moist climates. For cold, dry climates the Siberian form of *Medicago falcata* is much more promising." (*Hansen.*)

20572. Triticum vulgare. **Wheat.**

From the experiment station at Ultuna, near Upsala, Sweden. "(No. 52.) A very hardy, early winter wheat with short straw." (*Hansen.*)

20573. Vicia cracca. **Bird vetch.**

From the Ultuna district, central Sweden. "(No. 53.) The wild form of this promising forage plant from 60° N. lat." (*Hansen.*)

20574. Lotus corniculatus. **Bird's-foot trefoil.**

From Sweden. "(No. 54.) A promising native leguminous forage plant with yellow flowers. Seed collected about 121 miles north of Ultuna, 62° N. lat., by the father of Doctor Elofson, for the experiment station at Ultuna." (*Hansen.*)

20521 to 20795—Continued.

20575. LATHYRUS PRATENSIS. **Meadow pea.**

From Ultuna, 60° N. lat., Sweden. "(No. 55.) A native wild leguminous forage plant." (*Hansen.*)

20576. PHLEUM ALPINUM. **Mountain timothy.**

From Ultuna, Sweden. "(No. 56.) Native timothy from Sanding, in the Austrian Alps. Seed grown the second year at the experiment station at Forsse, 63° N. lat., in 1906. The present sample is from Dr. E. O. Arenander, at the experiment station at Ultuna." (*Hansen.*)

20577. VICIA CRACCA. **Bird vetch.**

From the Vesterbotten district, Sweden. "(No. 57.) A valuable forage plant collected from wild plants in northern Sweden, north of the Polar Circle, in the Vesterbotten district, 64° N. lat. Over 80 per cent of the seeds are hard, so should be prepared by scratching by the Svalöf method before sowing." (*Hansen.*)

20578. TRIFOLIUM PRATENSE. **Red clover.**

From Bodoe, Norway. "(No. 58.) Wild red clover collected on the Landingeness farm, near the experiment station at Bodoe, 67° N. lat." (*Hansen.*)

20579. HORDEUM HEXASTICHUM. **Six-row barley.**

From Tjeldnaes, Loedingen district, Norway. "(No. 59.) A spring barley which ripens in 94 days. From 68° 20′ N. lat." (*Hansen.*)

20580. HORDEUM VULGARE. **Barley.**

From Stroemmen, Tysfjord district, 68° N. lat., Norway. "(No. 60.) A spring barley which ripens in 96 days." (*Hansen.*)

20581. HORDEUM VULGARE. **Barley.**

From Hammeroe district, 68° N. lat., Norway. "(No. 61.) A spring barley which ripens in 93 days." (*Hansen.*)

20582. HORDEUM VULGARE. **Barley.**

From Moljord, Beieren district, Norway. "(No. 62.) A spring barley of very ancient cultivation in this district; lat 66° 54′." (*Hansen.*)

20583. HORDEUM VULGARE. **Barley.**

From Liland, Evenaes district, 68° 29′ N. lat., Norway. (No. 63.) Spring barley.

20584. AVENA SATIVA. **Oat.**

From Breirem, Vefsen district, Norway. "(No. 64.) Spring oats from 65° 55′ N. lat., where they ripen in 91 days." (*Hansen.*)

20585. SECALE CEREALE. **Rye.**

From Aaenget, Mo district, Norway. "(No. 65.) Spring rye from 66° 20′ N. lat., where it ripens in 120 days. Aaenget is about 10 Norwegian miles from the coast." (*Hansen.*)

20586. SECALE CEREALE. **Rye.**

From Hjertoe, Nordfolden district, Norway. "(No. 66.) Winter rye from 67° 40′ N. lat. This rye has been cultivated for many years in this locality." (*Hansen.*)

20587. HORDEUM VULGARE. **Barley.**

From Trysil, Hatfjelddalen district, Norway. "(No. 67.) One of the very earliest varieties of spring barley, which ripens on sandy soil in 98 days. Trysil is a mountain village in the Trysil Valley in Nerli; latitude 65° 32′." (*Hansen.*)

20521 to 20795—Continued.

20588. Hordeum vulgare. **Barley.**

From Nerli, Hatfjelddalen district, Norway. "(No. 68.) Spring barley grown at Nerli on very sandy soil; latitude 65° 32'. The harvest often fails in this locality." (*Hansen.*)

20589. Avena sativa. **Oat.**

From Vefsen district, latitude 65° 30', Norway. (No. 69.) Spring oats.

20590. Festuca elatior. **Tall fescue.**

From Mjoes, Vardahl, Christiania province, Norway. "(No. 70.) Wild seed selected by Director Nielsen, of the experiment station at Bodoe; latitude 67°." (*Hansen.*)

20591. Pisum arvense. **Field pea.**

From Bodoe, Norway. "(No. 71.) *Sveding.* A field pea originally introduced from Denmark by Mr. Sebastian Larson, of Aas, Norway; grown for the past twelve years in Norway—the last two at the Bodoe Experiment Station. Does well on sandy soil at Bodoe and ripens in 120 days." (*Hansen.*)

20592. Hordeum vulgare. **Barley.**

From Bodoe,. Norway. "(No. 72.) Spring barley from the experiment station at Bodoe; latitude 67°." (*Hansen.*)

20593. Phleum pratense. **Timothy.**

From Christiania, Norway. "(No. 73.) Native timothy, No. 469, from A. Michelet, seedsman. The claim in Norway is that the native is hardier than that introduced." (*Hansen.*)

20594. Brassica rapa. **Turnip.**

From Mjelde, near Tromsoe, Norway. "(No. 74.) Mjelde is near 70° N. lat. Turnips are found very useful for stock feeding north of the Arctic Circle in Lapland." (*Hansen.*)

20595. Lolium perenne. **Perennial rye-grass.**

From Aas, Norway. "(No. 75.) Native name *Yaedersk Raigrass.* Native grass from the upland district of southern Norway. This sample is from the experiment station at Aas." (*Hansen.*)

20596. Hordeum vulgare. **Barley.**

From Bjaerkoe, an island on the coast of northern Norway. "(No. 76.) An extremely early spring barley." (*Hansen.*)

20597. Lupinus angustifolius (?).

From Aas, Norway. "(No. 77.) A perennial forage plant from the experiment station at Aas." (*Hansen.*)

20598. Brassica rapa. **Turnip.**

From Aas, Norway. "(No. 78.) The yellow Finland turnip, from the experiment station at Aas." (*Hansen.*)

20599. Brassica rapa. **Turnip.**

From Aas, Norway. "(No. 79.) Swedish turnip from the experiment station at Aas; obtained in 1902 from Mustiala, Finland." (*Hansen.*)

20600. Hordeum vulgare. **Barley.**

From the island of Donnes, Nordland, Norway. "(No. 80.) *Donnes.* Spring barley from the large estate Donnes, the proprietor of which is Mr. Isaac Coldevin, of Nordoevaagen. Donnes is an island in Nordland, the Arctic Circle province of Norway. This variety is not so early, but is more productive than the *Bjoerkeby* barley. Sample from the experiment station at Aas." (*Hansen.*)

20521 to 20795—Continued.

20601. Brassica rapa. **Turnip.**

From Budalen, Trondilagen in Roeraastrakten, Norway. "(No. 81.) Received through the experiment station at Aas." (*Hansen.*)

20602. Festuca rubra. **Red fescue.**

From the Guldbrand Valley, Norway. "(No. 82.) A desirable native lawn grass." (*Hansen.*)

20603. Brassica rapa. **Turnip.**

From Vefsen, Nordland, the Arctic Circle province of Norway. "(No. 83.) Swedish turnip." (*Hansen.*)

20604. Brassica rapa. **Turnip.**

From Foerland, Ryfylke in Stavanger province, Norway. "(No. 84.) Swedish turnip." (*Hansen.*)

20605. Brassica rapa. **Turnip.**

From Bjoerli, in the Guldbrand Valley, Norway. (No. 85.)

20606. Lathyrus pratensis. **Meadow pea.**

From Aas, Norway. "(No. 86.) A wild leguminous forage plant found in the vicinity of Aas." (*Hansen.*)

20607. Hordeum vulgare. **Barley.**

From Bjoerkoe Island, Norway. "(No. 87.) Spring barley." (*Hansen.*)

20608. Hordeum vulgare. **Barley.**

From Donnes, Norway. "(No. 88.) *Donnes.* A very early spring barley." (*Hansen.*)

20609. Vicia cracca. **Bird vetch.**

From the experiment station at Otava, Finland. "(No. 89.) 1905 seed. *Vicia cracca* is coming to the front as a valuable forage plant in Finland, and hence merits special attention for cool, moist climates." (*Hansen.*)

20610. Avena sativa. **Oat.**

From the experiment station at Otava, Finland. "(No. 90.) Native black oats." (*Hansen.*)

20611. Vicia cracca. **Bird vetch.**

From the experiment station at Otava, Finland. "(No. 91.) The same as No. 89 (S. P. I. No. 20609), but is 1906 seed." (*Hansen.*)

20612. Andropogon sorghum. **Sorghum.**

From Manchuria. "(No. 92.) *Gaolan.* Brought by a Russian student-soldier from Manchuria after the Russo-Japanese war." (*Hansen.*)

20613. Trifolium elegans. **Clover.**

From Viatka, Russia. "(No. 93.) Native red clover from Viatka, near Perm, in the northern Volga River section in eastern Russia. This is about 58° latitude. A drought-resistant steppe clover." (*Hansen.*)

20614. Agropyron dasyanthum.

From Moscow, Russia. "(No. 94.) A valuable Russian steppe grass originally from a single spike. This is No. 2635 of Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20521 to 20795—Continued.

20615. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 95.) Grown from seed originally from Don province, southern Volga River region, Russia. See No. 167 (S. P. I. No. 20688). Variety D. This lot was selected for its larger and heavier seeds." (*Hansen.*)

20616. AGROPYRON SIBIRICUM.

From Moscow, Russia. "(No. 96.) The original mixture of elementary species from the Trans-Ural region east of Orenburg; hence, in extreme western Siberia. A valuable grass for dry steppes. This is No. 2636 of Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20617. ASTRAGALUS GLYCYPHYLLOS.

From Don province, Russia. "(No. 97.) A leguminous forage plant from the dry steppes of Don province of the Volga River region of southeastern Russia." (*Hansen.*)

20618. POA ALPINA.

From Kazan province, Russia. "(No. 98.) A good native pasture grass from Kazan province of the northern Volga region in European Russia." (*Hansen.*)

20619. PANICUM ERUCIFORME.

From Poltava province, south-central Russia. "(No. 99.) A desirable native grass." (*Hansen.*)

20620. ANDROPOGON SORGHUM. **Sorghum.**

From Ussurie province, Siberia. "(No. 100.) *Gaolan.* This variety grows from 20 to 25 feet in height, and during the Russo-Japanese war the Cossacks on horseback found trouble in getting through the sorghum fields, as they would be lost from view even with their spears." (*Hansen.*)

20621. ANDROPOGON SORGHUM. **Sorghum.**

From Ussurie province, Siberia. "(No. 101.) *Gaolan.* For description see No. 100 (S. P. I. No. 20620). The head does not appear as compact as in No. 100. Seed brought from Manchuria by Russian student-soldiers after the Russo-Japanese war." (*Hansen.*)

20622. AGROPYRON DESERTORUM.

From the Trans-Ural region, Siberia. "(No. 102.) A drought-resistant grass from the dry steppes." (*Hansen.*)

20623. AGROPYRON sp.

From Moscow, Russia. "(No. 103.) This is from a single seed selected by Professor Williams, of the Moscow Agricultural College, from a plant with long, upright stolons from the Orenburg region on the boundary between European Russia and Siberia. Promising as a grass for dry, cold regions." (*Hansen.*)

20624. PHLEUM PRATENSE. **Timothy.**

From Podolsk province, Russia. "(No. 104.) Wild native timothy." (*Hansen.*)

20625. ANDROPOGON SORGHUM. **Sorghum.**

From Asiatic Russia. "(No. 105.) One of the best varieties cultivated by the native Mohammedans in Russian central Asia, east of the Caspian Sea. The native variety is *Ak-ju-gah-rah.*" (*Hansen.*)

20521 to 20795—Continued.

20626. AGROPYRON CYLINDRICUM.

From Moscow, Russia. "(No. 106.) The first generation from a single seed selected by Professor Williams, of the Moscow Agricultural College, from a black-seeded form of a grass from Odessa, southern Russia, on the Black Sea." (*Hansen.*)

20627. ANDROPOGON SORGHUM. **Sorghum.**

From Manchuria. "(No. 107.) Native name *Tjic-choo-meed-zha.* This variety is used for brooms in Manchuria. Seed brought from Manchuria by a Russian student-soldier after the Russo-Japanese war." (*Hansen.*)

20628. PHLEUM BOEHMERI. **Timothy.**

From Moscow, Russia. "(No. 108.) Variety *macrantha.* A drought-resistant species of timothy from the east Russia steppes, where *Bromus inermis* is native. This is No. 2492A of Professor Williams, of the Moscow Agricultural College. The plants are not so tall as the species, but have very long spikes." (*Hansen.*)

20629. GLYCINE HISPIDA. **Soy bean.**

From Manchuria. "(No. 109.) Variety *Hoo-an-dooh.* Used for human food and for fodder in Manchuria and brought from that country by a Russian student-soldier after the Russo-Japanese war." (*Hansen.*)

20630. ASTRAGALUS CICER.

From Poltava province, southern European Russia. "(No. 110.) A native leguminous forage plant." (*Hansen.*)

20631. PHLEUM ASPERUM. **Timothy.**

From Turgai province, western Siberia. "(No. 111.) A native timothy from the dry steppes of Turgai province. The very small seeds may be an objection to this species, but this may be remedied by selection." (*Hansen.*)

20632. AGROPYRON SIBIRICUM.

From Moscow, Russia. "(No. 112.) Variety *latifolia*, form *A.* A promising drought-resistant grass from the Trans-Ural region of western Siberia. See also No. 96 (S. P. I. No. 20616)." (*Hansen.*)

20633. PERILLA OCYMOIDES. **Perilla.**

From Ussurie province, Siberia. (No. 113.) *Zooza.*

20634. PHLEUM BOEHMERI Wibel.

From Kiev, Russia. "(No. 114.) Seed from a single plant of the tall-growing native form." (*Hansen.*)

20635. AGROPYRON ELONGATUM.

From the Trans-Ural region, Siberia. "(No. 115.) Seed from a single plant of a native grass from the dry steppes." (*Hansen.*)

20636. ASTRAGALUS HYPOGLOTTIS.

From Potalva province, Russia. "(No. 116.) A native leguminous forage plant." (*Hansen.*)

20637. AGROPYRON SIBIRICUM.

From Moscow, Russia. "(No. 117.) Variety *angustifolia*, form *B.* A promising grass from the dry steppes of the Trans-Ural region, western Siberia. See also No. 96 (S. P. I. No. 20616)." (*Hansen.*)

20521 to 20795—Continued.

20638. Trifolium lupinaster.

From Tobolsk, Siberia. "(No. 118.) A native clover from the dry steppes of Tobolsk, where it endures —40° F. The seed should be scratched with sand or by the Svalöf method to insure germination the first year; otherwise many of the seeds will not germinate until the second year." (*Hansen.*)

20639. Agropyron intermedium.

From the Trans-Ural region, Orenburg province, Siberia. "(No. 119.) A collection of elementary species of a promising grass from the dry steppes of the Trans-Ural region of the Orenburg province. This province extends on both sides of the Ural range of mountains, which forms the natural boundary between European Russia and Siberia. The *non-aristate* plants, those without spines or long barbs on the seeds, should be selected as the only form desirable for cultivation." (*Hansen.*)

20640. Panicum miliaceum. **Broom-corn millet.**

From northwestern China. (No. 120.) *Meeza.*

20641. Lathyrus montanus.

From Tobolsk, Siberia. "(No. 121.) 1902 seed. A very good wild leguminous forage crop." (*Hansen.*)

20642. Koeleria cristata.

From Moscow, Russia. "(No. 122.) 1905 seed. Fourth generation from seed originally from Turgai province, a dry steppe region of western Siberia. This is one of the best steppe grasses." (*Hansen.*)

20643. Koeleria cristata.

From Moscow, Russia. "(No. 123.) 1904 seed. Third generation from seed originally from Don province, Volga River region, southern Russia. One of the best steppe grasses. This is No. 2560 of the Moscow Agricultural College." (*Hansen.*)

20644. Coronilla varia. **Crown vetch.**

From Don province, Russia. "(No. 124.) 1903 seed. A hardy steppe legume from Don province. A very handsome plant, with white and rose colored flowers." (*Hansen.*)

20645. Astragalus asper.

From Kherzon province, southern Russia. "(No. 125.) 1904 seed. A leguminous forage plant." (*Hansen.*)

20646. Elymus sabulosus.

From Moscow, Russia. "(No. 126.) Found on sand dunes in southeastern Russia in the Volga River region. The hay is of no value, but it is good fodder when green. The horses on the dry steppes like the seed more than they do oats and get fat on it. This is No. 1181 of the Moscow Agricultural College." (*Hansen.*)

20647. Vicia villosa. **Hairy vetch.**

From Khavrof, Vladimir province, Russia. "(No. 127.) A well-known forage plant said to have come originally from western Asia. It is now cultivated to some extent in the United States." (*Hansen.*)

20648. Bromus erectus. **Upright brome-grass.**

From the Kazan province, central Volga River region, Russia. "(No. 128.) A very good steppe grass." (*Hansen.*)

20649. Cannabis sativa. **Hemp.**

From Tomsk province, Siberia. (No. 129.)

20521 to 20795—Continued.

20650. LATHYRUS PRATENSIS. **Meadow pea.**

From Kazan province, Volga River region, Russia. "(No. 130.) A tall plant with yellow flowers. A very good fodder plant, very common in the steppe region; a long-lived perennial." (*Hansen.*)

20651. VICIA SEPIUM. **Vetch.**

From Perm-Ufa region, Russia. "(No. 131.) A very good fodder plant, very common in northeastern Russia, including the Volga, Kazan, Ufa, and Perm provinces. A long-lived perennial and a beautiful plant." (*Hansen.*)

20652. ALOPECURUS RUTHENICUS. **Russian foxtail.**

From Russia. "(No. 132.) A good steppe grass from the dry steppe country of extreme eastern Russia and western Siberia in the Ural, Orenburg, and Trans-Ural region." (*Hansen.*)

20653. CHAETOCHLOA ALOPECUROIDES.

From Manchuria. "(No. 133.) Native name *Hoon-kood-zha.* A very good forage plant; also used for porridge by the natives of Manchuria. The present seed was brought by a Russian student-soldier from Manchuria after the Russo-Japanese war. The seeds of this millet are small, light reddish yellow; spikes long and dense, made up of many subspikes." (*Hansen.*)

20654. TRIFOLIUM ALPESTRE.

From Samara province, Russia. "(No. 134.) A wild red clover from Samara province, Volga River region, eastern Russia. Some authorities call this *Trifolium medium.* It is highly regarded as a drought-resistant clover for the dry steppes, where it is found native." (*Hansen.*)

20655. TRIFOLIUM MONTANUM.

From Moscow, Russia. "(No. 135.) First generation from seed originally from Kharkov province. This is the only clover (Trifolium) that is native to the south Russian steppes. It is not a heavy cropper, but is very drought resistant." (*Hansen.*)

20656. TRIFOLIUM MONTANUM.

From Voronesh province, Volga River region, eastern Russia. (No. 136.)

20657. TRIFOLIUM LUPINASTER.

From Tobolsk province, Siberia. "(No. 137.) Native clover from the Siberian steppes." (*Hansen.*)

20658. TRIFOLIUM MEDIUM. **Mammoth clover.**

From Moscow, Russia. "(No. 138.) Seed originally from one plant of a wild steppe clover from the Kazan province, Volga River region, central-eastern Russia. Seed selected by Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20659. TRIFOLIUM PRATENSE. **Red clover.**

From Perm province, Russia. "(No. 139.) A native red clover of the Perm province, from the northern part of the Volga River region. This is considered one of the best forms of the Russian clover, as it is from the far north." (*Hansen.*)

20660. TRIFOLIUM MONTANUM.

From Saratov province, Russia. "(No. 140.) A drought-resistant clover as found in the dry steppe region from Saratov province south to Voronesh province in the Volga River region of eastern Russia." (*Hansen.*)

20521 to 20795—Continued.

20661. TRIFOLIUM AGRARIUM.

From Moscow province, Russia. "(No. 141.) Native clover; worthy of trial for meadows, but probably not of especial promise." (*Hansen.*)

20662. TRIFOLIUM FILIFORME.

From Moscow, Russia. "(No. 142.) Seed of the third or fourth generation of a native clover from the Kazan province. Worthy of trial, though not especially promising. Grown by Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20663. TRIFOLIUM PRATENSE. **Red clover.**

From Sterlitomack district, Ufa province, Volga River region, Russia. "(No. 143.) Wild red clover. At the Moscow Agricultural College the red clovers from Perm and Ufa provinces have been found to be the best forms of the Russian red clover." (*Hansen.*)

20664. TRIFOLIUM PROCUMBENS.

From Orel province, Volga River region, Russia. "(No. 144.) Wild clover." (*Hansen.*)

20665. TRIFOLIUM PANNONICUM. **Hungarian clover.**

From Saratov province, Volga River region, Russia. "(No. 145.) Native clover." (*Hansen.*)

20666. TRIFOLIUM PANNONICUM. **Hungarian clover.**

From western Europe. "(No. 146.) Commercial seed to compare with No. 145 (S. P. I. No. 20665)." (*Hansen.*)

20667. PHLEUM BOEHMERI.

From Moscow, Russia. "(No. 147.) This species of timothy is found native in the steppes of eastern Russia and in Siberia, and resists severe drought and cold. There is reason to hope that it will be valuable as a westward extension of the common timothy, as it is native in much of the same region where *Bromus inermis* is at home. The present seed is from the Kazan province, Volga River region, from a low-growing form; originally from a single spike. It is No. 2492 of Professor Williams's selection at the Moscow Agricultural College." (*Hansen.*)

20668. PHLEUM BOEHMERI.

From Moscow, Russia. "(No. 148.) This is the same as No. 147 (S. P. I. No. 20667), except that it is from a higher growing plant. This species is easily distinguished from common timothy by the fact that the spike subdivides into large subspikes when sharply bent, whereas in common timothy the spike separates evenly throughout." (*Hansen.*)

20669. FAGOPYRUM TATARICUM. **India wheat.**

From Tomsk province, Siberia. (No. 149.)

20670. PHLEUM BOEHMERI.

From Moscow, Russia. "(No. 150.) This is the same as Nos. 147 and 148 (S. P. I. Nos. 20667 and 20668), except that it is the fourth generation from one plant from the Kazan province selected by Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20671. GENISTA TINCTORIA.

From Don province, Volga River region, Russia. "(No. 151.) Variety *depressa*. A very good pasture plant." (*Hansen.*)

20672. ORYZA SATIVA. **Upland rice.**

From China. "(No. 152.) Considered to be a first-class variety. Sent from China to the Moscow Agricultural College." (*Hansen.*)

20521 to 20795—Continued.

20673. Bromus sterilis.

From Poltava province, Russia. "(No. 153.) If sown in the fall the seeds may scatter so that it becomes a very bad weed; but if sown in the spring it gives a fine grass for cutting by June and July. It seeds in August and hence should be cut early." (*Hansen.*)

20674. Zea mays. Corn.

From Khokand, Russian Turkestan. "(No. 154.) Indian corn grown by the Mohammedans at Khokand. This white, rather flinty corn has probably been selected for drought resistance. The kernels are small." (*Hansen.*)

20675. Panicum crus-galli. Barnyard millet.

From Ussurie province, Siberia. "(No. 155.) This is our barnyard grass as found native in the Ussurie province of the Pacific coast section of Siberia. It is considered a good forage plant there, although coarse. A Japanese form of this species has been introduced by a western seedsman as *Billion-Dollar* grass." (*Hansen.*)

20676. Phleum boehmeri.

From Samara province, Russia. "(No. 156.) Seed gathered by Mr. Klingen, government agronomist, in 1904. See No. 147 (S. P. I. No. 20667)." (*Hansen.*)

20677. Chaetochloa alopecuroides.

From Ussurie province, Siberia. "(No. 157.) See No. 133 (S. P. I. No. 20653)." (*Hansen.*)

20678. Panicum miliaceum. Broom-corn millet.

From Manchuria. "(No. 158.) The common millet of Manchuria. The present seed was brought by a Russian student-soldier from Manchuria after the Russo-Japanese war." (*Hansen.*)

20679. Stipa pennata.

From Moscow, Russia. "(No. 159.) Variety *graffiana*. The Kirghiz Tartar horses are fond of it and will dig away the snow in winter to get at it. It is best for pasture and should be cut after the seeds, which are heavy, fall. The long-tailed seeds are hygroscopic, and when they get into the wool of a sheep they screw their way into its flesh, sometimes killing the animal. After the seeds blow away the grass is found to be nutritious. The present seed is No. 2476 of Professor Williams, of the Moscow Agricultural College, and is the first generation from the original seed gathered in 1904 from Turgai province, in western Siberia, east of Orenburg, which is on the boundary line of European Russia and Siberia." (*Hansen.*)

20680. Triticum vulgare. Wheat.

From Kargopol, Olonetz province, Russia. "(No. 160.) Winter wheat from Kargopol, which is about 210 miles southwest of Archangel, hence almost up to the Arctic Circle, where there is often not much snow." (*Hansen.*)

20681. Chaetochloa viridis. Green foxtail.

From Moscow, Russia. "(No. 161.) This is an annual grass very good for hay in the Caucasus and Siberia, but considered a weed in central Russia. In the Caucasus the natives call it 'timothy grass hay.' The present seed is the sixth or seventh generation under cultivation by Professor Williams, of the Moscow Agricultural College, of the forms of the species from Kharkov and Don provinces. At Moscow it would be regarded rather as a weed because it is not cultivated and timothy is better; in fact, timothy becomes very near being a perennial at Moscow." (*Hansen.*)

20521 to 20795—Continued.

20682. MELILOTUS OFFICINALIS. **Yellow sweet clover.**

From Daghestan province, Transcaucasia, bordering on the Caspian Sea. "(No. 162.) A dwarf form; considered a very good fodder plant." (*Hansen.*)

20683. MELILOTUS ALBA (and M. OFFICINALIS).

From the banks of the Msta River, Novgorod province, Russia. "(No. 163.) Nos. 162 and 163 (S. P. I. Nos. 20682 and 20683) may prove too near the sweet clover to win favor." (*Hansen.*)

20684. ORYZA SATIVA. **Upland rice.**

From Khokand province, Russian Turkestan. (No. 164.)

20685. PISUM ARVENSE(?). **Field pea.**

"(No. 165.) A winter pea which is cultivated by the Cossacks in southwestern Russia, in the lower Volga River region, as a forage plant. In western Russia and Poland it is used for human food also, but is considered of poor quality. Sow in the fall." (*Hansen.*)

20686.. STIPA CAPILLATA.

From Turgai province of the steppe section of western Siberia. " No. 166.) Considered one of the best grasses for pasture." (*Hansen.*)

20687. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 167.) Variety A. From seed of one plant selected for its large seeds by Professor Williams from his No. 2637 at the Moscow Agricultural College. A good grass from the dry steppes." (*Hansen.*)

20688. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 168.) The original seed from which No. 167 (S. P. I. No. 20687) was selected, originally from Don province, southern Volga River region, Russia. A good grass from the dry steppes." (*Hansen.*)

20689. AGROPYRON CYLINDRICUM.

From Moscow, Russia. "(No. 169.) One of the best grasses from Don province, southern Volga River region, Russia. Usually a biennial, but sometimes lasts three years. Mow before it gets woody. This is the second generation from the original seed of one plant and is No. 2643 from Professor Williams, of the Moscow Agricultural College." (*Hansen.*)

20690. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 170.) Variety B. The same as No. 167 (S. P. I. No. 20687); from one plant, but with smaller seed." (*Hansen.*)

20691. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 171.) Variety E. The same as No. 167 (S. P. I. No. 20687); from seed of one plant." (*Hansen.*)

20692. AGROPYRON CRISTATUM.

From Moscow, Russia. "(No. 172.) Variety C. The same as No. 167 (S. P. I. No. 20687)." (*Hansen.*)

20693. CHAETOCHLOA VIRIDIS. **Green foxtail.**

From Tomsk province, Siberia. "(No. 173.) This is considered a weed at Moscow, Russia, but makes a very good hay as found in the Caucasus and in Siberia. This sample is the native form from Tomsk province and is a mixture of elementary species." (*Hansen.*)

20521 to 20795—Continued.

20694. CHAETOCHLOA ALOPECUROIDES.

From Khokand, Russian Turkestan. "(No. 174.) This millet makes very good hay, and cattle are fond of the seeds. It is also used by the natives as food. As found wild, there are two forms, one of yellow and one of red seed, and the two forms should be separated before sowing." (*Hansen.*)

20695. CHAETOCHLOA ALOPECUROIDES.

From Ussurie province, Pacific coast section, Siberia. "(No. 175.) Native form. See No. 174 (S. P. I. No. 20694)." (*Hansen.*)

20696. PHASEOLUS RADIATUS. **Mung bean.**

From Khokand, Russian Turkestan. "(No. 176.) Native *Masch*. A native legume." (*Hansen.*)

20697. PANICUM CRUS-GALLI. **Barnyard millet.**

From north China. "(No. 177.) Native name *Pisa*. See No. 155 (S. P. I. No. 20675)." (*Hansen.*)

20698. PHASEOLUS RADIATUS. **Mung bean.**

From Ussurie province, Pacific coast section, Siberia. "(No. 178.) Chinese name *Lango*. A native legume." (*Hansen.*)

20699. GLYCINE HISPIDA. **Soy bean.**

From Ussurie province, Pacific coast section, Siberia. "(No. 179.) From the farm of Mr. Fick, near Nicolsk." (*Hansen.*)

20700. CHAETOCHLOA sp.

From Ussurie province, Siberia. "(No. 180.) This is one of the best forage plants of the Ussurie province of the Pacific coast section of Siberia, and was used freely for the Russian horses in the Russo-Japanese war. The native name is *Choomeeza*. The sample is a mixture of red-yellow seeds, with the yellow largely predominating." (*Hansen.*)

20701. CHAETOCHLOA ALOPECUROIDES.

From Manchuria. "(No. 181.) Native name *Hoon-kood-zha*. A yellow-seeded variety of millet brought from Manchuria by a Russian student-soldier in the Russo-Japanese war." (*Hansen.*)

20702. ANDROPOGON SORGHUM. **Sorghum.**

From Jahzavan, Marghilan district, Russian Turkestan. "(No. 182.) Native name *Joo-gar-ah*. A drought-resistant forage plant especially adapted to hot, dry climates. See No. 190 (S. P. I. No. 20710)." (*Hansen.*)

20703. PHASEOLUS ANGULARIS. **Adzuki bean.**

From south Ussurie, Pacific coast section, Siberia. "(No. 183.) *Weido*. A leguminous forage plant." (*Hansen.*)

20704. PANICUM CRUS-GALLI. **Barnyard millet.**

From Manchuria. "(No. 184.) Native name *Zan-Zah*. A good forage plant brought from Manchuria after the Russo-Japanese war." (*Hansen.*)

20705. ORYZA SATIVA. **Upland rice.**

From Manchuria. "(No. 185.) Native name *Zoo-za-mic*. Its northern origin makes it worthy of attention on the northern borders of our rice belt." (*Hansen.*)

20706. ANDROPOGON SORGHUM. **Sorghum.**

From south Ussurie, Pacific coast section, Siberia. "(No. 186.) *Gaolan*." (*Hansen.*)

20521 to 20795—Continued.

20707. Astragalus vesicarius.

From Kharkov, southern Russia. "(No. 187.) A wild fodder plant." (*Hansen.*)

20708. Astragalus falcatus.

From Don province, southern Volga River region, Russia. "(No. 188.) A good forage plant from the dry steppes." (*Hansen.*)

20709. Phleum alpinum. **Mountain timothy.**

From Moscow, Russia. "(No. 189.) A promising species of native timothy from the dry steppes of the Turgai province of western Siberia. The plant grows ordinarily as high as timothy. This is No. 2491 of Professor Williams, of the Moscow Agricultural College, who finds it has already shown a great improvement in size of seed, the seed as found in its native habitat being rather small. The present stock is originally from a single seed." (*Hansen.*)

20710. Andropogon sorghum. **Sorghum.**

From Jahzavan, Marghilan province, Russian Turkestan. "(No. 190.) One of the best varieties; called *Ak-juh-gar-ah* by the native Mohammedans. These central Asiatic sorghums have dense heads of round, white kernels which are much used for feeding stock. The heads bend sharply in the stalk, so that they point downward when mature. Promising for dry hot climates where Indian corn suffers from hot winds. See No. 182 (S. P. I. No. 20702)." (*Hansen.*)

20711. Medicago sativa. **Alfalfa.**

From Moscow, Russia. "(No. 191.) *Turkestan.* The present sample is originally from Tashkent, the capital of Russian Turkestan, grown at Moscow, and originally the seed came from one plant. At the Moscow Agricultural College, Professor Williams has found this strain very hardy, very productive, and a beautiful plant, while the French lucern, by which is meant the ordinary south European or North African form of the species, winterkills at Moscow." (*Hansen.*)

20712. Medicago denticulata. **Bur clover.**

From Moscow, Russia. "(No. 192.) This makes a good forage plant in Italy, but is worthless at Moscow; originally from Italy." (*Hansen.*)

20713. Medicago denticulata. **Bur clover.**

From Don province, lower Volga River region, southeastern European Russia. "(No. 193.) A good native forage plant. The seed pods are very spiny, so are found very undesirable for sheep pastures, as the spines stick to the wool." (*Hansen.*)

20714. Medicago media. **Sand lucern.**

From Moscow, Russia. "(No. 194.) Originally from a single plant growing wild in the Voronesh province of the central Volga River region, Russia. It is a natural hybrid of *M. falcata* and *M. sativa* and found wild in the dry steppes. This spontaneous or natural hybrid will sometimes have blue flowers on one branch, yellow on another, and sometimes both colors on the same branch. The present sample is the fourth generation raised by Professor Williams at the Moscow Agricultural College and is his No. 571×572." (*Hansen.*)

20715. Medicago media. **Sand lucern.**

From Moscow, Russia. "(No. 195.) The same source as No. 194 (S. P. I. No. 20714), and also the fourth generation from a single plant found wild in the dry steppes of the Voronesh province. The present strain bears yellow flowers; in fact, it is almost *M. falcata* in its characteristics and is not as heavy a yielder as Nos. 194 and 196 (S. P. I. Nos. 20714 and 20716)." (*Hansen.*)

20521 to 20795—Continued.

20716. MEDICAGO MEDIA. **Sand lucern.**

From Moscow, Russia. "(No. 196.) Originally from a single plant found wild in the dry steppes of the Voronesh province, eastern Russia, and is now the fourth generation under cultivation. A beautiful plant, very hardy, very productive, and with black-green flowers." (*Hansen.*)

20717. MEDICAGO FALCATA. **Yellow lucern.**

From Kharkof province, southeastern Russia. "(No. 197.) A wild form." (*Hansen.*)

20718. MEDICAGO FALCATA. **Yellow lucern.**

From Omsk, western Siberia. "(No. 198.) The Siberian alfalfa as found wild at Omsk. In my Siberian investigations I learned that as found wild upon the Siberian steppes this is a valuable forage plant in regions where the mercury freezes sometimes without snow; that it is green very early in the spring; that it endures severe drought; that it does well upon soils underlaid with hardpan; that it is considerably resistant to alkali; that it flourishes where common alfalfa from Europe winterkills; that the Siberian form of this species is so much superior to the European form in hardiness and other desirable characteristics that to go by the botanical name only is very misleading. The present sample is from hay cut from wild plants before my arrival." (*Hansen.*)

20719. MEDICAGO FALCATA. **Yellow lucern.**

From Omsk, Siberia. "(No. 199.) This sample I picked from wild plants in the dry steppes near Omsk late in the fall when there was a little snow on the ground. I found the plants held their own perfectly with other native plants in the compact prairie or steppe sod. Omsk is in latitude 55°." (*Hansen.*)

20720. MEDICAGO FALCATA. **Yellow lucern.**

From Irkutsk, on Lake Baikal, eastern Siberia. "(No. 200.) Picked from a load of wild hay brought to the market at Irkutsk by the Buriats (native Mongolians)." (*Hansen.*)

20721. MEDICAGO FALCATA. **Yellow lucern.**

From Samara province, Russia. "(No. 201.) As found wild in Samara province. See No. 206 (S. P. I. No. 20726)." (*Hansen.*)

20722. MEDICAGO FALCATA. **Yellow lucern.**

From Saratov province, central Volga River region of eastern Russia, adjoining Siberia. "(No. 202.) As found wild in Saratov province." (*Hansen.*)

20723. PRUNUS NANA. **Russian almond.**

From Omsk, Siberia. "(No. 203.) As found native at Omsk." (*Hansen.*)

20724. MEDICAGO FALCATA. **Yellow lucern.**

From Tomsk, Siberia. "(No. 204.) As found wild at Tomsk." (*Hansen.*)

20725. MEDICAGO FALCATA. **Yellow lucern.**

From Moscow, Russia. "(No. 205.) Sample of the third generation under cultivation by Professor Williams, of the Moscow Agricultural College, of seed obtained from wild plants in Don province of the lower Volga River region of southeastern Russia." (*Hansen.*)

20726. MEDICAGO FALCATA. **Yellow lucern.**

From Samara province, Russia. "(No. 206.) Another sample of seed from wild plants of this promising forage plant. See No. 201 (S. P. I. No. 20721)." (*Hansen.*)

20521 to 20795—Continued.

20727. ASTRAGALUS FALCATUS.

From Kherson province, Russia. "(No. 207.) A native leguminous forage plant from the province of Kherson." (*Hansen.*)

20728. MELILOTUS OFFICINALIS. **Yellow sweet clover.**

From Donskaya district on the north coast of the Black Sea, Russia. "(No. 208.) This is perhaps variety *macrorhiza*. Grows from 7 to 9 feet in height. Seed from native plants. Used as a honey plant, but the odor is too strong for a good forage plant. It is evident that the sweet clover has possibilities as a forage plant, but that considerable work in plant breeding appears necessary before it will find wide popularity." (*Hansen.*)

20729. STIPA PENNATA.

From Turgai province, western Siberia. (No. 209.)

20730. ONOBRYCHIS ONOBRYCHIS. **Sainfoin.**

From Samara province, Russia. "(No. 210.) A leguminous forage plant as found wild in the dry steppes." (*Hansen.*)

20731. PYRUS SINENSIS. **Pear.**

From St. Petersburg, Russia. "(No. 211.) *Pyrus ussuriensis;* this is the same as *P. sinensis*, but it is worth while to make a distinction. This sample is from the original plants brought by Maximowicz from Ussurie province, Siberia, growing at St. Petersburg, where it is perfectly hardy, while the Chinese form winterkills. The fruits are bergamotte shaped, about 2 inches in diameter. This Siberian form of the pear is probably the hardiest known." (*Hansen.*)

20732. ASTRAGALUS HYPOGLOTTIS.

From Tomsk province, Siberia. "(No. 212.) A wild leguminous forage plant; considered of value for forage." (*Hansen.*)

20733. TRIFOLIUM sp. **Clover.**

From Omsk, Siberia. "(No. 213.) The wild red clover as found native at Omsk. Here it occurs sparingly in the steppes." (*Hansen.*)

20734. HALIMODENDRON ARGENTEUM. **Salt tree.**

From Djarkent, northern Russian Turkestan, on the edge of China. "(No. 214.) A native, silver-leaved, small tree found in dry places." (*Hansen.*)

20735. TRIFOLIUM MONTANUM.

From Tomsk province, Siberia. "(No. 215.) A clover native on dry steppes. The large seeds of this wild Siberian clover are noteworthy. It is considered a good forage plant." (*Hansen.*)

20736. TRIFOLIUM ALPESTRE. **Clover.**

From Samara province, northern Volga River region, eastern Russia. "(No. 216.) A promising wild clover from the dry steppes." (*Hansen.*)

20737. TRIFOLIUM PRATENSE. **Red clover.**

From Sarapul, Viatka province, northern Volga River region, eastern Russia. "(No. 217.) Wild red clover as found in the dry steppes at Sarapul, about 56° 25′ N. lat." (*Hansen.*)

20738. FESTUCA OVINA. **Sheep's fescue.**

From Samara province, Russia. "(No. 218.) Native fescue grass found wild." (*Hansen.*)

20521 to 20795—Continued.

20739. Astragalus glycyphyllos.

From Tomsk province, Siberia. "(No. 219.) A leguminous forage plant as found wild." (*Hansen.*)

20740. Poa pratensis. **Kentucky bluegrass.**

From Samara province, northern Volga River region, eastern Russia. "(No. 220.) A good grass; found wild." (*Hansen.*)

20741. Agropyron repens. **Couch-grass.**

From Samara province, Russia. "(No. 221.) The wild white clover of Samara." (*Hansen.*)

20742. Melilotus alba. **Sweet or Bokhara clover.**

From Samara province, Russia. "(No. 222.) As found wild in Samara." (*Hansen.*)

20743. Onobrychis onobrychis. **Sainfoin.**

From Omsk, Siberia. "(No. 223.) A leguminous forage plant as found wild on the dry steppes." (*Hansen.*)

20744. Orobus luteus.

From Tomsk province, Siberia. "(No. 224.) A leguminous forage plant, considered valuable for forage, from the Beryl Valley of the Altai Mountain region, Tomsk province. It is found up to a height of 2,000 meters." (*Hansen.*)

20745. Vicia sp.

From Vladivostok, Siberia. "(No. 225.) Seed of a wild leguminous forage plant found in wild hay brought to the Mongolian hay market at Vladivostok. Value not determined." (*Hansen.*)

20746. Trifolium sp. **Clover.**

From Irkutsk, Siberia. "(No. 226.) Seed of a wild clover gathered when the plants were frozen on moist soil near Irkutsk." (*Hansen.*)

20747. Trifolium sp. **Clover.**

From Samara province, Russia. "(No. 227.) A wild red clover allied to the common red clover but not of the same species." (*Hansen.*)

20748. Festuca rubra. **Red fescue.**

From Samara province, Russia. "(No. 228.) A good grass found wild in the dry steppes." (*Hansen.*)

20749. Panicum miliaceum. **Broom-corn millet.**

From Turgai province, Siberia. "(No. 229.) Native name *Salma-bas-tara.* A large-seeded yellow millet. A promising variety, as it is native on dry steppes." (*Hansen.*)

20750. Orobus lathyroides.

From Tomsk province, Siberia. "(No. 230.) A wild leguminous forage plant." (*Hansen.*)

20751. Panicum miliaceum. **Broom-corn millet.**

From Turgai province, Siberia. "(No. 231.) Native name *Kar-sak-ajak-tara.* This appears to be much the same as No. 229 (S. P. I. No. 20749). Both are promising, as they are native on dry steppes." (*Hansen.*)

20752. Phleum boehmeri Wibel.

From Samara province, Russia. "(No. 232.) Native timothy as found wild in the dry steppes." (*Hansen.*)

20521 to 20795—Continued.

20753. PANICUM MILIACEUM. **Broom-corn millet.**

From Turgai province, western Siberia. "(No. 233.) Native name *Kunak-tara*. A wild millet. Much the same as Nos. 229 and 231 (S. P. I. Nos. 20749 and 20751), but with smaller seeds." (*Hansen.*)

20754. PANICUM MILIACEUM. **Broom-corn millet.**

From Turgai province, western Siberia. "(No. 234.) Native name *Kisil-ala-tara*. The seeds of this wild millet are large, mostly white, ripening to yellow. All the native millets from Turgai province are used for porridge by the natives. This common dish is called 'Kasha' by the natives." (*Hansen.*)

20755. PANICUM MILIACEUM. **Broom-corn millet.**

From Turgai province, western Siberia. "(No. 235.) Native name *Yak-tara*. A wild millet, the seeds of which are large and white." (*Hansen.*)

20756. VICIA sp. **Vetch.**

From Irkutsk, on Lake Baikal, eastern Siberia. "(No. 236.) A wild legume common in the wild hay brought in by the Buriats to Irkutsk." (*Hansen.*)

20757. VICIA sp. **Vetch.**

From Omsk, Siberia. "(No. 237.) A wild leguminous forage plant. Value undetermined but considered promising." (*Hansen.*)

20758. BROMUS INERMIS. **Smooth brome-grass.**

From Besentsuk, Samara province, Russia. "(No. 238.) Found wild near the experiment station at Besentsuk, upper Volga River region. Native of dry steppes." (*Hansen.*)

20759. BROMUS ERECTUS. **Upright brome-grass.**

From Besentsuk, Samara province, Russia. "(No. 239.) A native grass of the dry steppes." (*Hansen.*)

20760. AGROPYRON CRISTATUM.

From Samara province, Russia. "(No. 240.) A promising grass from the dry steppes." (*Hansen.*)

20761. VITIS AMURENSIS. **Grape.**

From northern Manchuria. "(No. 241.) The wild grape of northern Manchuria as found along the line of the Siberian railway." (*Hansen.*)

20762. TRIFOLIUM ALPESTRE.

From Sarapul, Russia. "(No. 242.) A wild clover found native on the dry steppes in Viatka province, Russia. This seed is from Sarapul, which is about 56° 25′ N. lat. Promising as a clover resistant to severe cold and drought." (*Hansen.*)

20763. AGROPYRON DESERTORUM.

From Samara province, Russia. "(No. 243.) A promising wild grass from the dry steppes." (*Hansen.*)

20764. PINUS CEMBRA.

From Irkutsk, Siberia. "(No. 244.) The native pine of Siberia." (*Hansen.*)

20765. PANICUM MILIACEUM. **Broom-corn millet.**

From Turgai province, Siberia. "(No. 245.) Native name *Sara-tara*. Native millet from the dry steppes; the large white seeds are used for human food. Considered to be a very good variety." (*Hansen.*)

20521 to 20795—Continued.

20766. Orobus luteus.

From Omsk, Siberia. "(No. 246.) A promising native leguminous forage plant found wild." (*Hansen.*)

20767. Panicum miliaceum. **Broom-corn millet.**

From Tugai province, Siberia. "(No. 247.) A yellow-seeded millet, native to dry steppes. Taken out of No. 235 (S. P. I. No. 20755)." (*Hansen.*)

20768. Panicum miliaceum. **Broom-corn millet.**

From Turgai province, Siberia. "(No. 248.) A yellow-seeded millet, native to dry steppes. Taken out of No. 245 (S. P. I. No. 20765)." (*Hansen.*)

20769. Cucumis melo. **Muskmelon.**

From the Imperial Botanical Garden, St. Petersburg, Russia. "(No. 249.) Gathered by Dr. Kochanovsky in 1906 in Mongolia. This variety ought to be of value in the north." (*Hansen.*)

20770. Lathyrus magellanicus.

From Lago San Martin, Patagonia, South America. "(No. 250.) Seed gathered by A. Thesleff in a Swedish scientific expedition and sent to the Botanical Gardens at Helsingfors, Finland, Russia, in 1905. A native forage plant of Magellan Straits." (*Hansen.*)

20771. Lathyrus nervosus.

From Patagonia, South America. "(No. 251.) Seed gathered by A. Thesleff in a Swedish scientific expedition and sent to the Botanical Gardens at Helsingfors, Finland, Russia, in 1905." (*Hansen.*)

20772. Trifolium pratense. **Red clover.**

From Christiania, Norway. "(No. 252.) The Toten clover, which is cultivated over large areas of Norway on account of its extreme hardiness. It is descended from a wild plant found at Toten, Norway, by a peasant about 1850. This form has sometimes been called *Trifolium pratense norvegica*. The present sample is No. 442 of Mr. A. Michelet, seedsman, Christiania, Norway." (*Hansen.*)

20773. Trifolium pratense. **Red clover.**

From Christiania, Norway. "(No. 253.) The agronomists of Norway claim that the native red clover is hardier than that introduced from America and that the plant is much smoother. I found the same claim as to greater freedom from hairiness of plant, causing the hay to be more free from dust, made for the native red clovers of Finland and Russia. No. 439 of Mr. A. Michelet." (*Hansen.*)

20774. Trifolium hybridum. **Alsike clover.**

From Christiania, Norway. "(No. 254.) The Norwegian form of the alsike clover. No. 252 of Mr. A. Michelet." (*Hansen.*)

20775. Medicago sativa. **Alfalfa.**

From Christiania, Norway. "(No. 255.) A hardy, vigorous, broad-leaved form of alfalfa found in Norway by Mr. O. Malthe. The present variety was selected a few years ago by Mr. Malthe from a patch of alfalfa cultivated in Norway for a score of years. Considered to be a promising mutation." (*Hansen.*)

20776. Lathyrus sylvestris.

From Christiania, Norway. "(No. 256.) A hardy leguminous forage plant as found native a score of years ago in the Romerike Valley, a few miles north of Christiania." (*Hansen.*)

20521 to 20795—Continued.

20777. Pinus cembra.

From Tomsk, Siberia. "(No. 257.) The common pine over a large section of central Siberia. The large seeds are a favorite dainty for dessert on Siberian tables." (*Hansen.*)

20778. Pyrus intermedia.

From Helsingfors, Finland. "(No. 258.) A native ornamental tree. The bright red berries are borne in great abundance and resemble those of a mountain ash." (*Hansen.*)

20779. Berberis sp. **Barberry.**

From Djarkent, northern Russian-Turkestan, on the edge of China. "(No. 259.) A large-berried variety remarkable for the intense dark red color of the juice. It may prove to be *Berberis heteropoda*, which is a market berry in Turkestan." (*Hansen.*)

20780. Pyrus sinensis. **Japanese pear.**

From Harbin, northern Manchuria. "(No. 260.) This pear is of poor quality, but juicy, and is representative of the pears of northern China and Manchuria." (*Hansen.*)

20781. Sambucus racemosa.

From Helsingfors, Finland. "(No. 261.) The native red-berried elder." (*Hansen.*)

20782. Ribes rubrum. **Red currant.**

From Bodoe, Norway. "(No. 262.) The wild red currant from Bodoe, which is in 67° 20′ N. lat., on the coast of Norway." (*Hansen.*)

20783. Rubus chamaemorus. **Cloud berry.**

From Bodoe, Norway. "(No. 263.) The wild raspberry here." (*Hansen.*)

20784. Rubus idaeus. **European raspberry.**

From Bodoe, Norway. "(No. 264.) A yellow-fruited form of the wild raspberry." (*Hansen.*)

20785. Fragaria vesca. **Strawberry.**

From Bodoe, Norway. "(No. 265.) The wild strawberry from north of the Arctic Circle." (*Hansen.*)

20786. Hordeum vulgare. **Barley.**

From St. Petersburg, Russia. "(No. 266.) *Jarenskianum* × (*pallidum* × *lapponicum*), No. 448 of Dr. Robert Regel, of the Bureau of Applied Botany, Department of Agriculture, St. Petersburg. This is a representative of the barley grown on the northern boundary of barley culture in the provinces of Vologda and Archangel. Of special promise for Alaska and regions where the growing period is short." (*Hansen.*)

20787. Alopecurus pratensis. **Meadow foxtail.**

From Helsingfors, Finland. "(No. 267.) A valuable grass highly regarded as making hay of as good quality as timothy. Suitable for moist soil. Finland exports an immense quantity of this, which is probably the best native grass, to other countries." (*Hansen.*)

20788. Trifolium pratense. **Red clover.**

From Helsingfors, Finland. "(No. 268.) Native red clover of Finland. Claimed to be hardier than the red clover from America and a smoother plant." (*Hansen.*)

20521 to 20795—Continued.

20789. PHLEUM PRATENSE. **Timothy.**

From Finland. "(No. 269.) Native timothy of Finland. Timothy is found both in North America and Europe; in Europe it extends up to and north of the Arctic Circle." (*Hansen.*)

20790. TRIFOLIUM PRATENSE. **Red clover.**

From Perm province, European Russia. "(No. 270.) The Russian form of red clover." (*Hansen.*)

20791. TRIFOLIUM PRATENSE. **Red clover.**

From Olonetz province, Russia. "(No. 271.) Variety *pallidum*. Wild red clover, promising for very cold, rather moist regions." (*Hansen.*)

20792. LOTUS CORNICULATUS. **Bird's-foot clover.**

From Samara province, Russia. "(No. 272.) A wild leguminous forage plant as found native in Samara province." (*Hansen.*)

20793. RAPHANUS SATIVUS. **Radish.**

From Kioto, Japan. "(No. 273.) *Daikon*. Seed of a large, roundish radish. This radish appears to be a common article of food in Japan, as I saw it in the markets of Tokio. It attains a size of 8 inches in diameter. However, the quality is said to be very poor by European residents in Japan." (*Hansen.*)

20794. RAPHANUS SATIVUS. **Radish.**

From Kioto, Japan. "(No. 274.) A large, long, white variety." (*Hansen.*)

20795. CELOSIA sp. **Cockscomb.**

From Kioto, Japan. "(No. 275.) A cockscomb with large, bright red flowers of the ostrich-feather type, grown in the flower gardens at Kioto. Seed purchased in the bazaar at Kioto." (*Hansen.*)

20796 to 20798.

From Manchuria and China. Received through Mr. Frank N. Meyer, agricultural explorer, April 3, 1907.

20796. HORDEUM VULGARE. **Barley.**

From Mukden, Manchuria. "(No. 720a.) *Black* barley. Chinese name *Gai ta mi*. Said to be used sprouted as an addition to sweetmeats. A rather rare variety." (*Meyer.*)

20797. GLYCINE HISPIDA. **Soy bean.**

From Shanghai, China. "(No. 722a.) *Black* soy beans obtained through Dr. S. P. Barchet, of the U. S. consulate at Shanghai. These beans come from Chin-hua-fu, Chekiang province, and are used apparently as a second crop on low-lying rice fields, and may as such be very valuable for the Southern States. They are mainly used as a food for domestic animals. It seems that they are sown broadcast after the sowing of the rice crop; specific details are not obtainable just now." (*Meyer.*)

20798. GLYCINE HISPIDA. **Soy bean.**

From Shanghai, China. "(No. 723a.) *Brown* soy beans obtained through Dr. S. P. Barchet, of the U. S. consulate at Shanghai. These beans come from Chin-hua-fu, Chekiang province, and are used apparently as a second crop on low-lying rice fields, and may as such be very valuable for the Southern States. They are mainly used as a food for domestic animals." (*Meyer.*)

20800. PHOENIX DACTYLIFERA. **Date.**

From Washington, D. C. Received through the California Fruit Company, April 8, 1907.

"*Deglet Noor* dates for the propagation of seedling date orchards in the Southwest." (*Swingle.*)

20801 to 20805. RHEUM spp.

From Cornhill, Liverpool, England. Received from The Cooperative Bees (Limited) through Mr. David Fairchild, April 1, 1907.

20801. RHEUM COMPACTUM.

20802. RHEUM OFFICINALE.

20803. RHEUM MACROCARPUM.

20804. RHEUM TATARICUM.

20805. RHEUM ACUMINATUM.

For cooperative experimental work on production of new rhubarb varieties with Mr. J. B. Wagner, Pasadena, Cal. (*Fairchild.*)

20806. SOLANUM TUBEROSUM. **Potato.**

From Erfurt, Germany. Received from Messrs. Haage & Schmidt, April 6, 1907.

Mäuschen. "A potato highly esteemed in Germany and by Americans abroad for its fine texture and good flavor. It is about the size of a full-grown mouse and has much the appearance of one, whence the name. Its shape and firmness make it very desirable for salads.

"Imported on request of several parties to determine whether it will retain its high quality after several generations in this country." (*Fischer.*)

20808. CANARIUM COMMUNE. **Tropical almond.**

From Buitenzorg, Java, Dutch East Indies. Presented by Dr. M. Treub, director of the Department of Agriculture, April 2, 1907.

"There is probably not a more beautiful avenue tree in the world. The most beautiful avenue in the famous Gardens of Buitenzorg is of this species, and for this purpose alone it is worthy of the consideration of the landscape gardeners of the western Tropics. Avenues of this tree should be planted in Porto Rico, Cuba, and especially on the Canal Zone.

"Aside from its value as an avenue tree, its nuts have found a use in the Dutch East Indies in the preparation of a substitute for mothers' milk. The researches of Dr. W. G. Boorsma have shown this to be of unusual value for infants.

"To prepare the emulsion which is the principal ingredient of this baby food, the meat of the nut is removed from the shell, and also the thin skin which surrounds it, by putting it in hot water. These kernels are put in a mortar with an equal weight of milk sugar and are pounded up together into a dough-like mass, which is gradually mixed with a larger and larger quantity of water. The grinding of the kernels is assisted by the hard crystals of the milk sugar. After filtering through a cloth which has been washed in boiling water, the mass of kernels and sugar are wet with water again, and again pressed. This process may be repeated several times. The wet emulsion is added to cows' milk and the mixture sterilized. The oily layer which separates itself and lies on top of the sterilized preparation can be again mixed with the milk by vigorous shaking until only a few flocculent masses remain attached to the sides of the flask.

"See Dr. W. G. Boorsma, in 'Oorspronkelijke Bijdragen.—Lahmann's 'plantaardige melk' en kanarizaden-emulsie als toevoegsel tot de melk voor zuigelingen. (Geneeskundig Tijdschrift voor Ned.-Indië Deel, XLI, afl. 4.) Batavia Jav. Boekh. & Drukkerij, 1901. Also in kanarizaden-emulsie als toevoegsel tot voor zuigelingen bestemde koemelk. (Geneeskundig Tijdschrift voor Ned.-Indië Deel, XLV, afl. 1.) Batavia Jav. Boekh. & Drukkerij, 1905. As species of Canarium occur in the Philippines, this use of their seed should be called to the attention of Americans in Manila.

"This new vegetable fat is, furthermore, perhaps worthy of the attention of American pharmacologists." (*Fairchild.*)

20809 to 20812.

From Buenos Aires, Argentina. Presented by the Buenos Aires Botanical Garden, through Mr. C. V. Piper, April 6, 1907.

20809. LATHYRUS NERVOSUS.

20810. LATHYRUS SERICEUS.

20811. PASPALUM PARANENSE.

20812. STIPA ICHU.

20814. CUCURBITA MAXIMA. Squash.

From Venice, Italy. Received through Dr. Erwin F. Smith, of this Department, April 5, 1907.

"Collected in September, 1906. A large squash with thick flesh and small cavity; of good quality and the best variety seen in the streets of Venice, where it is sold baked in halves." (*Smith.*)

20837. CUCUMIS MELO. Muskmelon.

From Chios, Turkey. Presented by Mr. N. J. Pantelides. Received February, 1907.

Khios.

20838 to 20842.

From Shanghai, China. Received through Mr. Frank N. Meyer, agricultural explorer, April 9, 1907.

A collection of cuttings and plants.

20838 and 20839. VIBURNUM ODORATISSIMUM.

"Nos. 646 and 647. Cuttings of a beautiful, large-leaved, evergreen shrub, growing to a height of 15 feet, bearing many clusters of white flowers. A very fine shrub for the mild-wintered regions of the United States. Especially good for cemeteries and parks. Obtained from Mr. D. MacGregor, superintendent of the parks of Shanghai." (*Meyer.*)

20840 and 20841. OSTERDAMIA PUNGENS.

"Nos. 648 and 649. A grass used for lawns in the parks and open places in Shanghai. It is the only grass that can be kept green during the heat and drought of midsummer. It might be an excellent grass for gardens and parks in the southern United States. Obtained from Mr. D. MacGregor, superintendent of the parks of Shanghai." (*Meyer.*)

20842. BAMBUSA sp. Bamboo.

"No. 650. Shoots purchased in the vegetable market at Shanghai, where the plant is a favorite food with the Chinese. It is generally eaten boiled and sliced with rice, or in soups, although it is even better if fried in pork fat." (*Meyer.*)

20846. XANTHOSOMA SAGITTIFOLIUM. Yautia.

From Bahama Islands, British West Indies. Received through Mr. P. J. Wester, special agent, April 12, 1907.

"*Eddie*, the name by which this large variety is known in the Bahamas." (*Wester.*)

20854 to 20862.

From Harbin, Manchuria. Received through Mr. F. N. Meyer, agricultural explorer, April 11, 1907.

A miscellaneous collection of seeds.

20854. GLYCINE HISPIDA. Soy bean.

"(No. 675a, Dec. 15, 1906.) Green soy beans; Chinese name *Ta shing toa.* These are boiled and used as food, and the sprouts of the germinated beans are also used as a vegetable throughout the winter months." (*Meyer.*)

20854 to 20862—Continued.

20855. CANNABIS SATIVA. **Hemp.**

"(Nos. 676a and 677a, Dec. 19, 1906.) Purchased in the market in Harbin, where the seeds are sold as bird food." (*Meyer.*)

20856. CHAETOCHLOA ITALICA. **Siberian millet.**

"(No. 678a, Dec. 19, 1906.) Chinese name *Hong shu tse.* It is used by the Chinese as food, being boiled and eaten in the form of a paste or as a porridge. Used by the Russians as a bird seed." (*Meyer.*)

20857. PANICUM MILIACEUM. **Broom-corn millet.**

"(No. 679a, Dec. 19, 1906.) Chinese name *Pai shu tse.* It is used by the Chinese the same as the preceding number, and is also used by the Russians as a bird seed." (*Meyer.*)

20858. TRITICUM VULGARE. **Wheat.**

"(No. 680a, Nov. 30, 1906.) Purchased near Ninguta. It is considered a very good wheat. It consists, however, of many varieties grown together; hence, many different types may appear." (*Meyer.*)

20859. FAGOPYRUM ESCULENTUM. **Buckwheat.**

"(No. 681a, Nov. 30, 1906.) A large variety of buckwheat grown by the Chinese on the sterile mountain sides near Ninguta." (*Meyer.*)

20860. PAPAVER SOMNIFERUM. **Opium poppy.**

"(No. 683a, Dec. 19, 1906.) A black poppy used in confectionery and as a bird seed." (*Meyer.*)

20861. PAPAVER SOMNIFERUM. **Opium poppy.**

"(No. 684a, Dec. 19, 1906.) A white poppy used in confectionery and as a bird seed." (*Meyer.*)

20862. BETULA sp. **Birch.**

From Corvuskaya, Siberia. "(No. 686a, Nov. 24, 1906.) A shrubby birch growing 5 to 8 feet tall with gray branches. Useful as a park shrub in northern regions." (*Meyer.*)

20863 to 20864.

From Huimanguillo, Tabasco, Mexico. Presented by Mr. A. G. Weiss, through Mr. O. W. Barrett, April 13, 1907.

20863. IPOMOEA BATATAS. **Sweet potato.**

Red Camote.

20864. XANTHOSOMA SAGITTIFOLIUM. **Yautia.**

Macal. Red, smooth variety.

20865. SECHIUM EDULE. Chayote.

From Huimanguillo, Tabasco, Mexico. Presented by Mr. A. G. Weiss, April 12, 1907.

Two small smooth fruits and one large prickly fruit.

20867 to 20869.

From Victoria, Tamaulipas, Mexico. Presented by Dr. Edward Palmer, April 15, 1907.

20867. SECHIUM EDULE. **Chayote.**

Large, spiny, yellowish fruits.

20867 to 20869—Continued.

20868. PHYSALIS IXOCARPA. **Ground cherry.**

A large-fruited variety.

20869. FICUS sp. **Wild fig.**

Small fruits.

20870 to 20871. NEPHELIUM spp.

From Kuching, Sarawak. Presented by Mr. John Hewitt, curator of the Sarawak Museum, April 18, 1907.

20870. *Buoh Mo.* White. 20871. *Buoh Mo.* Red.

"Possibly these are *N. formatum.*" (*Hewitt.*)

20873. ANDROPOGON SORGHUM. **Sorghum.**

From Bombay, Kirkee, India. Presented by Prof. G. A. Gammie, economic botanist, Ganeshkhind Botanical Gardens, through Mr. David Fairchild, April 10, 1907.

"*Juar.* Said to be a dwarf variety." (*Gammie.*)

20876. CASTILLA sp. **Rubber.**

From Ancon, Canal Zone, Panama. Received through Mr. Henry F. Schultz, April 19, 1907.

20877. ASPARAGUS sp. **Asparagus.**

From Cape Town, South Africa. Received from Mr. J. S. Henkel, Acting Conservator of Forests, Western Conservancy, March 19, 1907.

Imported for experiments in the breeding of disease-resistant strains of asparagus.

20879. PHASEOLUS sp.

From Miami, Florida. Received through Mr. W. F. Wight, of the Bureau of Plant Industry, April 22, 1907.

"Collected on farm of Captain Haden, some miles south of Miami. Source unknown, but probably introduced with a large number of other plants from various parts of the world introduced by him." (*Wight*).

20880. AGAVE RIGIDA ELONGATA. **Henequen.**

From St. Louis, Mo. Received through Dr. Wm. Trelease, director, Missouri Botanical Garden, April 20, 1907.

"Plants representing the true gray henequen or gray sisal of Yucatan. They are what botanists currently call *Agave rigida elongata.*" (*Trelease.*)

20890. CARLUDOVICA PALMATA.

From Ancon, Canal Zone, Panama. Received through Mr. Henry F. Schultz, April 23, 1907.

20891 to 20894.

From Kobe, Japan. Presented by Hon. Hunter Sharp, American consul, who purchased them from J. Ikeda & Co., Tokyo, Japan. Received March 25, 1907.

20891 to 20894—Continued.

20891. DOLICHOS LABLAB. **Hyacinth bean.**

Fujimame.

20892. GLYCINE HISPIDA. **Soy bean.**

White.

20893. GLYCINE HISPIDA. **Soy bean.**

Green.

20894. PHASEOLUS ANGULARIS. **Adzuki bean.**

20895. IPOMOEA FUCHSIOIDES.

From Miami, Fla. Received through Dr. E. A. Bessey, Subtropical Laboratory, April 25, 1907.

"A most excellent thing and destined to be a great favorite among lovers of morning-glories. It grows wild in the hammocks around Miami. In its native state it makes poor growth; but a vine in culture in the garden at Miami for two years has made immense growth and is covered nearly all the year with brilliant carmine-colored blooms. It seeds exceedingly sparsely. The plant is tuberous, and it is believed that if the roots were covered during the winter it would grow at least as far north as North Carolina." (*Wester.*)

20900 to 20906.

From Victoria, Tamaulipas, Mexico. Presented by Dr. Edward Palmer, March 25, 1907.

20900 to 20905. PHASEOLUS VULGARIS. **Bean.**

20900. *Amarillo.*

20901. *Garbancillo.*

20902. *Gordo.*

20903. *Morado.*

20904. *Baylo chico.*

20905. *Negro chico.*

20906. ERVUM LENS. **Lentil.**

20907. PSOPHOCARPUS TETRAGONOLOBUS.

From Columbia, Isle of Pines, West Indies. Presented by Dr. F. R. Ramsdell, April 26, 1907.

20908. CANANGA ODORATA. **Ilang ilang.**

From Manila, P. I. Presented by Mr. W. S. Lyon, horticulturist, Bureau of Agriculture, through Mr. O. W. Barrett, April 26, 1907.

"Mr. Creelman, the war correspondent, called on the Assistant Secretary of Agriculture and stated that it was his belief that the Ilang ilang might be grown in southern Florida and its remarkably fragrant blossoms shipped to our northern markets and sold—much as the Cape jasmine is now imported from the south and handled by the florists of our big cities. It is Mr. Creelman's belief that a small industry could be started with this flower and that its remarkable fragrance would attract the immediate attention of flower lovers." (*Fairchild.*)

20909 to 20922.

From Finland. Received April 20, 1907.

20909. HORDEUM VULGARE. **Barley.**

20910. SECALE CEREALE. **Rye.**

20911. PISUM SATIVUM. **Pea.**

20909 to 20922—Continued.

20912. PISUM SATIVUM. **Pea.**

20913. ALLIUM CEPA. **Onion.**

20914. BRASSICA OLERACEA. **Kale.**

20915. BRASSICA OLERACEA. **Kale.**

20916. BRASSICA OLERACEA. **Cabbage.**

20917. BRASSICA OLERACEA. **Cabbage.**

20918. BRASSICA RAPA. **Turnip.**

20919. CUCUMIS SATIVUS. **Cucumber.**

20920. CUCUMIS SATIVUS. **Cucumber.**

20921. CUCUMIS SATIVUS. **Cucumber.**

20922. LACTUCA SATIVA. **Lettuce.**

20923. HIBISCUS SABDARIFFA. **Roselle.**

From Alexandria, Egypt. Presented by Mr. V. F. Naggiar, November 6, 1906.

"From the calyx of this species is prepared one of the most attractive and delicious jellies known. It has been discovered that this jelly can be made not only from the calyx, but from all the succulent portions of the plant. As this species will grow, during our summers, as far north as New York, or perhaps farther, it is worthy of trial by all those interested in fancy jellies." (*Fairchild.*)

See Farmers' Bulletin No. 307, by P. J. Wester.

20924 to 20934. ORYZA SATIVA. **Rice.**

From Calcutta, India. Presented by Mr. A. T. Gage, superintendent of the Royal Botanic Garden, Sibpur. Received February 25, 1907.

20924. *Kalam dan* paddy.

20925. *Shela* paddy.

20926. *Srikole* paddy.

20927. *Bhusikar* paddy.

20928. *Bansmate* paddy.

20929. *Behula* paddy.

20930. *Kedali* paddy.

20931. *Sita bhoge* paddy.

20932. *Thakar bhoge* paddy.

20933. *Ash baran* paddy.

20934. *Nagpur* paddy.

20935 and 20936. ORYZA SATIVA. **Rice.**

From Yokohama, Japan. Received through Sale & Frazar (Limited), April 23, 1907.

20935. *Hang choo.*

20936. *Kun po.*

20937. CITRUS MEDICA ACIDA. **Lime.**

From Port of Spain, Trinidad. Presented by Mr. E. André, April 30, 1907.

Dominica Spineless.

20938 to 20942.

From Moyobamba, Peru. Presented by Mr. Serafin Filomeno, April 29, 1907.

20938. HEVEA BRASILIENSIS. **"Jebe" rubber.**

20939 to 20942. PHASEOLUS VULGARIS. **Bean.**

20939. Reddish brown, mottled with brick.

20940. Yellow brown.

20941. White.

20942. Mixed, purplish and light brown, mottled with purple.

20943. CINNAMOMUM CAMPHORA. **Camphor.**

From Kobe, Japan. Presented by Hon. Hunter Sharp, American consul, who purchased them from J. Ikeda & Co., Tokyo, Japan. Received March 25, 1907.

Cultural directions:

"*Soil and situation.*—The camphor tree prefers a fertile clay soil with southern aspect, where no cold wind blows. If there are no cold winds, it thrives also in shaded places, but the most favorable situation is a valley open to the south or southeast, with much moisture and with a warm sea breeze.

"*Seeding.*—The seeds are sown in March as soon as there is no danger from frost, being covered with about one-third of an inch of soil. As soon as they begin to grow they must be carefully weeded.

"The following year about the middle of June, when the sprouts are about 3 inches high, the plants are to be transplanted, and when the small white roots begin to grow they are transplanted again to a place where they should stay a year. The plants should have the leaves and roots severely pruned. The roots are cut to about 5 inches, and the stems are also cut.

"The weather for transplanting should be cloudy, or a day before a rain if possible.

"Two-year-old trees may be set out in a forest or garden, at which time the branches are pruned severely. Poorly grown plants, however, may remain for another season in the same ground." (*Prepared for Sharp.*)

20944. CAESALPINIA NAGU.

From Mindoro, P. I. Presented by Mr. W. S. Lyon, horticulturist, Bureau of Agriculture, by whom it was collected in March, 1907. Received April 29, 1907.

"Robust scandent shrub, ascending to 10 meters by means of small, scanty prickles; leaves coriaceous, lustrous, and very persistent; individual flowers small, canary yellow, grouped in large, showy terminal panicles, strongly and deliciously scented.

"Habitat, damp but well-drained clay soils at sea level. Tolerates occasional tidal overflows of brackish, but not pure, sea water.

"Flowers abundantly, but perfects seeds very sparingly. Worthy of cultivation." (*Lyon.*)

20945 to 20954.

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture, through Mr. O. W. Barrett, April 30, 1907.

20945 to 20948. COLOCASIA ANTIQUORUM. **Taro.**

20945. Variety *polyrhiza flava.*

"Kiempol koening."

20946. Variety *polyrhiza rubra.*

"Kiempol merah."

20947. Variety *polyrhiza alba.*

"Kiempol poetieh."

20948. Variety *polyrhiza.*

"Kiempol belang."

20949 and 20950. ALOCASIA MACRORHIZA. **Taro.**

20949. Variety *purpurascens.*

"Senteh merah."

20950. "Senteh belang."

20951 to 20954. COLOCASIA ANTIQUORUM. **Taro.**

20951. Variety *monorhiza.*

"Talus banteng ietem."

20952. Variety *monorhiza.*

"Talus banteng belang."

20945 to 20954—Continued.

20953. Variety *monorhiza.*

"Talus koekoek."

20954. Variety *monorhiza.*

"Talus belang."

20955 to 20967. CERATONIA SILIQUA. **Carob.**

From Lisbon, Portugal. Secured by Mr. Louis H. Aymé, United States consul-general, April 30, 1907.

"Scions of the finest 'alfarroba' trees to be found in the province of Algarve, the name of the plantation, proprietor, and the average annual production of the tree from which the grafts were cut being given with each." (*Aymé.*)

20955. From Valle da Arrencada, plantation of Joaquim Traquino; yield 50 to 60 pounds per annum.

20956. From Monte Alegre, plantation of Frederico da Paźmendes; yield 20 to 30 pounds per annum.

20957. From Serro dos Cörços, plantation of Dr. Alfredo Magathaes Barros; yield 30 to 40 pounds per annum.

20958. From Taipas, plantation of Visconde de Alvõr; yield 40 to 50 pounds per annum.

20959. From Quinto do Bispo, plantation of Brák Lamim; yield 15 to 20 pounds per annum.

20960. From Böa Vista, plantation of José Teiyeira Biker; yield 20 to 25 pounds per annum.

20961. From Alcurão, plantation of Antonio Vicente; yield 10 to 15 pounds per annum.

20962. From Chão das Donas, plantation of Antonio José da Motta; yield 35 to 40 pounds per annum.

20963. From Valle da Arrencada, plantation of Joaquim Traquino; yield 15 to 20 pounds per annum.

20964. From Böa Vista, plantation of Luis Antonio Maravithat; yield 30 to 40 pounds per annum.

20965. From Valle da Arrencada, plantation of Visconde de Alvõr; yield 15 to 20 pounds per annum.

20966. From Bem Parece, plantation of Conde de Silves; yield 16 to 20 pounds per annum.

20967. From Poço da Lagem, plantation of D. Luis Bordas y Marimon; yield 20 to 30 pounds per annum.

20968. GLYCYRRHIZA GLABRA. **Licorice.**

From Patras, Greece. Presented by Mr. F. B. Wood, British consul, March 6, 1907.

"Greek wild licorice roots." (*Wood.*)

20969. SYNGONIUM sp. **Vanilla.**

From Gomez Farias, Tamaulipas, Mexico. Presented by Dr. Edward Palmer, Victoria, Tamaulipas, Mexico, through Dr. J. N. Rose, U. S. National Museum, Washington, D. C. Received May 4, 1907.

(Rose's No. 07.277.)

20970 to 20973.

From Gomez Farias, Tamaulipas, Mexico. Presented by Dr. Edward Palmer, Victoria, Tamaulipas, Mexico, May 4, 1907.

20970. XANTHOSOMA sp. **Yautia.**

"*Rejalgar de castilla.* The young leaves and stalks are cooked as greens by the natives and are also cut up into bits and mixed with eggs,

20970 to 20973—Continued.

shrimps, and chile, forming a dish 'none will refuse.' Roots are also mashed and made into a gruel." (*Palmer.*)

20971 to 20973. IPOMOEA BATATAS. **Sweet potato.**

20971. Wild.

20972. White.

20973. Red.

20974. BARLERIA FLAVA.

From Mindoro, P. I. Presented by Mr. William S. Lyon, horticulturist, Bureau of Agriculture, by whom it was collected in March, 1907. Received May 4, 1907.

"Dwarf yellow-flowered shrub; very floriferous over period of six months. Thriving at sea level in shallow, rocky soils where exposed to nearly continuous drought from January to May." (*Lyon.*)

20976. RAPHANUS SATIVUS. **Radish.**

From Chico, Cal. Received through Mr. P. H. Dorsett, in charge of Plant Introduction Garden, April 13, 1907.

Seed raised from radishes sent in from Yang-tchow, China, in 1906, by Mr. Frank N. Meyer, agricultural explorer. (Meyer's No. 149.)

20977. ORYZA PUNCTATA. **Rice.**

From Cairo, Egypt. Presented by Dr. G. Schweinfurth, May 10, 1907.

"Wild *Scilluk* rice, gathered as a cereal by the Shilluk tribes in Lull, above Fashoda. Collected by Mr. Robert Tuerstig, Omdurman, British Egyptian Soudan." (*Schweinfurth.*)

20978 to 20979. PHYSALIS. **Husk tomato.**

From Queretaro, Mexico. Presented by Mr. M. M. Urquiza, through Mr. O. W. Barrett, May 13, 1907.

20978. Husk and fruit purple near stem.

20979. Husk and fruit yellowish near stem.

20980. VIGNA UNGUICULATA. **Cowpea.**

From Nairobi, British East Africa. Presented by Mr. Henry Powell, Director of Agriculture, through Mr. C. V. Piper, May 10, 1907.

20981 to 20984.

From Amani, German East Africa. Presented by Dr. Franz Stuhlmann, direktor des Kaiserlichen Biologisch-Landwirtschaftlichen Instituts, through Mr. C. V. Piper, May 8, 1907.

20981 and 20982. ANDROPOGON SORGHUM. **Sorghum.**

20981. *White durra.* "Kisuahili mgau."

20982. *White durra.* "Kisuahili fere-fere."

20983 and 20984. VIGNA UNGUICULATA. **Cowpea.**

20983. Brown, resembling *Red Ripper.*

20984. Mottled brown, resembling *New Era.*

20985 to 20987.

From St. Georges, Grenada, British West Indies. Presented by Mr. Rudolph I. Anstead, agricultural superintendent, Botanic Station, through Mr. O. W. Barrett, May 9, 1907.

20985 and 20986. XANTHOSOMA sp. **Yautia.**

20987. IPOMOEA BATATAS.

20989. ZIZYPHUS SPINA-CHRISTI. **Jujube, or Christ's-thorn.**

From Assiut, Egypt. Presented by Mr. Thomas W. Brown, secretary, La Société Horticole Commerciale, Cairo, May 14, 1907.

"A large edible-fruited variety of this species." (*Brown.*)

20990. CAREX TRIANGULARIS. **Sedge.**

From Rosenberg, Tex. Received through Mr. John H. Tull, special agent in charge of matting-rush investigations, United States Department of Agriculture, May 11, 1907.

"A sample of this sedge was discovered by Mr. R. H. Sawyer, of Malden, Mass., April 18, 1907, near the railroad station at Rosenberg, Tex. As it turns out to be a very promising species, his account of its discovery is worthy of record: During a delay caused by a breakdown on the railroad, as Mr. Sawyer was returning from Japan, where he had been in search of Japanese sedge and rush plants, he got out to explore the ditches and wet places for sedges and rushes, and this angular species attracted his attention. He gathered a few heads and collected a few plants, which he afterwards wove in his mills. Discovering that it was a native species occurring throughout Texas and Oklahoma and finding on weaving it that it was a specially promising variety, he requested that seeds be gathered in quantity. Mr. Tull was sent to Rosenberg, Tex., and collected the seed which forms the subject of this inventory description." (*Fairchild.*)

20991 to 21000. DIOSCOREA sp. **Yam.**

From Moamoa, Apia, Samoa. Presented by Brother Philippe, Marist Brothers' Agricultural College, through Mr. O. W. Barrett, May 14, 1907.

Samoan names accompanied the plants, as follows:

20991.	*Ufi vao.*	**20996.**	*Asoaso.*
20992.	*Calai.*	**20997.**	*Gu.*
20993.	*Laupalai.*	**20998.**	*Aumaile.*
20994.	*Tamuni.*	**20999.**	*Voli.*
20995.	*Asoasoulumoa.*	**21000.**	*Fakasoa.*

21001. PYRUS SINENSIS. **Pear.**

From Yokohama, Japan. Presented by the Yokohama Nursery Company (Limited). Received May 15, 1907.

"This pear seed was obtained at Heijo, some 150 miles by rail west of Seoul, Korea. The trees in the wild form are 20 feet high, and the trunks measure over 2 feet in diameter at the base. They spread out like the oak tree." (*Yokohama Nursery Company.*)

21002. BAMBUSA TULDA. **Bamboo.**

From Sibpur, Calcutta. Presented by Mr. A. T. Gage, superintendent, Royal Botanic Garden, May 16, 1907.

"*Habitat.*—This is the common bamboo of Bengal, where it grows in great abundance everywhere, flowering in May. 'Not uncommon in the deciduous forests of Pegu, generally occupying lower and moister stretches of ground in company with tinwa (*Cephalostachyum pergracile*), the dry hills surrounding being covered with *Dendrocalamus strictus.*' (*Brandis.*)

"'*Fiber.*—Largely used for mats, baskets, fans, and window blinds. This is, in fact, one of the most useful plants in Bengal.

"'*Food.*—The young shoots are pickled when only about two feet high. They are tender.' (*Roxburgh.*)

"'*Structure of the wood.*—The wood is strong, and the halms are used for roofing, scaffolding, mats, and other purposes.' (*Gamble.*)

"Found more durable if soaked in water previous to being used. This is regarded in Bengal as one of the best quality of bamboos. Both Roxburgh and Voigt mention several varieties. The following extract will be found to give the more important forms: '*Fowa bans* (*piabanshi?*) of the Bengalis is only a large variety of this species, and used chiefly for scaffolding and building the larger and better sorts of houses of the natives. It differs from *tulda* proper

21002—Continued.

in the greater length and thickness of the joints. *Basini bans* of the Bengalis is another variety of *tulda.* It has a larger cavity and is used chiefly to make baskets. *Behoor bans* is of a small size, very solid and strong, much bent to one side, and armed with numerous strong thorns, which renders it very fit for hedges. A staff of this species must be placed in the hand of every young Brahmin when invested with the sacerdotal cord; otherwise they say the ceremony can not be performed.' (*Roxburgh.*)

"The total annual rainfall in the district where this garden is situated is about 83.22 inches. There should be no difficulty in growing this bamboo in the West Indies." (*Gage.*)

21003 to 21004. Cyamopsis tetragonoloba. **Guar.**

From Bombay, India. Received through Latham & Co., May 18, 1907.

21003. *Talbuda.*

21004. *Sotia.*

21006. Vigna unguiculata. **Cowpea.**

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. William Hart, director of the Agricultural College, May 21, 1907.

Macassar. "The blue cowpea, known here as *Feijao macassar*, grows in the spring more slowly than such varieties as the Clay, Whippoorwill, Blackeye, Wonderful, and Rice, but outclasses them all in vigor and productiveness." (*Hart.*)

21007. (Undetermined.)

From Santiago, Chile. Presented by Señor Salvador Izquierdo, Calle Moneda 788, May 13, 1907.

"On a trip that I made into the mountains of the central part and along the coast of Chile I observed a plant, a creeper (?), which grows in places absolutely arid, where it receives no water except in the rainy seasons in the months of May and October, remaining in perfect vegetation the rest of the year; animals eat it rather eagerly. The appearance of the plant and its seeds would indicate that it belongs to the family Umbelliferæ. It might prove interesting to experiment with for the very dry regions of the United States." (*Izquierdo.*)

21008. Phoenix dactylifera. **Date.**

From Bagdad, Turkey in Asia. Received through Hills Bros. Company, New York, N. Y., May 18, 1907.

Zehedi. "For distribution to planters in the Southwest for the purpose of getting new seedling varieties." (*Swingle.*)

21009 to 21011. Phoenix dactylifera. **Date.**

From Washington, D. C. Received through Mr. H. L. Strang, May 23, 1907.

"Persian Gulf dates purchased in the open market. For distribution to planters in the Southwest for the purpose of getting new seedling varieties." (*Swingle.*)

21009. *Fard.*

21010. *Halawi.*

21011. *Khadrawi.*

21012. Aleurites cordata. **Japanese wood oil.**

From Kobe, Japan. Presented by Hon. Hunter Sharp, American consul, who purchased them from J. Ikeda & Co., Tokyo, Japan. Received March 25, 1907.

For comparison with the following (No. 21013)—Tung shu, or wood-oil tree.

21013. Aleurites fordii. **Tung, or Chinese wood oil.**

From Hankow, China. Secured by Hon. William Martin, United States consul-general, through Mr. David Fairchild, May 16, 1907.

21013—Continued.

For experiments in the propagation of this tree in America as a possible commercial source of Chinese wood oil and other products. (See S. P. I. No. 13104 and Daily U. S. Consular Report No. 2206.)

21014 to 21018.

From Melbourne, Victoria. Received through F. H. Brunning Pty. Ltd. Received May 22, 1907.

21014. DACTYLIS GLOMERATA. **Orchard grass.**

21015. FESTUCA ELATIOR. **Tall fescue.**

21016. FESTUCA PRATENSIS. **Meadow fescue.**

21017. POA PRATENSIS. **Kentucky bluegrass.**

21018. PHLEUM PRATENSE. **Timothy.**

21019. CITRUS MEDICA ACIDA. **Lime.**

From Dominica, British West Indies. Presented by Prof. Joseph Jones, curator, Botanic Station, May 24, 1907.

Dominica Spineless.

21020. OPUNTIA sp. **Tuna.**

From Alamogordo, New Mexico. Presented by Mr. A. B. Dille, May 27, 1907.

"This variety seems to grow very rank and vigorous and is almost entirely free from spines." (*Dille.*)

21021. GLYCYRRHIZA GLABRA. **Licorice.**

From Ispahan, Persia. Received through Mr. John Tyler, United States vice consul general, Teheran, Persia, May 31, 1907.

21023 to 21027.

From Auckland, New Zealand. Purchased from E. C. Pilkington & Co., June 1, 1907.

21023. FESTUCA SABULICOLA. **Chewing's fescue.**

21024. DANTHONIA SEMIANNULARIS. **Wallaby grass.**

21025. SPOROBOLUS ELONGATUS. **Rat-tail.**

21026. DACTYLLIS GLOMERATA. **Akaroa cock's-foot.**

21027. FESTUCA ELATIOR. **Tall fescue.**

21028 to 21029. LILIUM sp.

From Kinghwa, China. Received through Mr. J. M. W. Farnham, from Rev. T. D. Holmes, American Baptist Union, June 3, 1907.

"Golden yellow and cream-colored lilies, both rare, the cream colored being very rare. Blooms in July and August." (*Farnham.*)

21030 to 21031.

From Teguclgalpa, Honduras. Presented by Dr. Reinhold Fritzgartner, June 6, 1907.

21030. (Undetermined.)

"*Matasano.* A big tree; fruit the size of an orange or larger; skin green, with spiny pustules sparsely scattered over the surface; flesh white or yellow, sweet or slightly sour, containing two or three large black seeds." (*Fritzgartner.*)

21031. CARICA PAPAYA. **Papaw.**

"*Papaya*; a very large sized variety." (*Fritzgartner.*)

21033 to 21034.

From Venice, Italy. Presented by Hon. Paul Nash, American consul, June 7, 1907.

21033. Brassica oleracea. **Cabbage.**

"*Kupus*. From Ragusa, Dalmatia. In point of flavor the plant as grown there is very different from the ordinary European varieties, and highly prized by those who have eaten it. It appears that seeds produced in Ragusa have been planted in various parts of Europe, Asia Minor, and Africa, but the cabbages grown from them no longer retain the peculiar flavor of the *Kupus*. This is equally true of regions of the Dalmatian coast comparatively near Ragusa." (*Nash.*)

21034. Lagenaria sp. (?)

Procured from Fratelli Sgaravatti, Saonara, Padova, Italy.

"This is a delicious, slightly sweet vegetable called *Zucca*, resembling in form the cucumber and eaten stewed, fried, or boiled, and served cold as a salad. The flowers of the squash are also used here extensively, and when fried to a crisp are most delightful." (*Nash.*)

21039. Furcraea sp.

From Nice, France. Presented by Dr. A. Robertson Proschowsky, June 13, 1907.

The same as S. P. I. No. 21473.

21040 to 21043.

From Christchurch, New Zealand. Presented by Mr. L. Cockayne, Ollivier's Road, June 13, 1907.

21040. Myosotidium nobile.

"From Chatham Island; collected April, 1907." (*Cockayne.*)

21041. Veronica macroura.

Cooks Strait form.

21042. Pittosporum tenuifolium.

21043. Cassinia fulvida.

"Grows on sand dunes." (*Cockayne.*)

21044. Coleococcus amicarum. **Caroline ivory-nut palm.**

From Ponape, Caroline Islands, Oceanica. Presented by Mr. Wm. S. Lyon, horticulturist, Bureau of Agriculture, Manila, P. I., June 14, 1907.

"A pinnate-leaved palm introduced into Guam from the Caroline Islands. The nuts are of an ivory-like texture and are exported from the Carolines to Germany for button making. The spheroid fruit, about 7 cm. long and 8 cm. in diameter, has a reddish brown, glossy, scaly shell. The surface of the seed is glossy black and thickly striped, but not furrowed. The allied species of the Solomon Islands (*C. solomonensis*) has a straw-colored shell, and that of *C. vitiensis*, of Fiji, which is not used in the arts, is yellow. The inflorescence of this genus has not yet been described. In some of the Solomon Islands the natives prepare sago from the pith of the species growing there. It is said to keep well and not to be injured by salt water, so that it is a valuable food staple to take with them on their canoe voyages." (*Safford's Useful Plants of Guam.*)

21045. Araucaria imbricata. **Monkey-puzzle.**

From Coronel, Chile. Presented by Mr. Teodoro Finger, June 14, 1907.

21046 to 21047.

From Cienfuegos, Cuba. Presented by Dr. Robert M. Grey, Harvard Botanical Station, Central Soledad, June 14, 1907.

21046. GOSSYPIUM BARBADENSE. Cotton.

"(Var. *purpurascens.*) Red cotton from the hills." (*Grey.*)

21047. XANTHOSOMA VIOLACEUM. Yautia.

21050 to 21055.

From Mayaguez, P. R. Presented by Mr. M. J. Iorns, horticulturist, Agricultural Experiment Station, through Mr. O. W. Barrett, June 18, 1907.

21050. ARTOCARPUS INCISA. Breadfruit.

21051. CASSIA OCCIDENTALIS. "Ydionxa."

21052. HIBISCUS ABELMOSCHUS. "Algalia."

21053 to 21055. MUSA SAPIENTUM. Banana.

21053. *Palembang.* (ex. Kew.)

21054. *Popoulu.* (ex. Hawaii.)

21055. *Lele.* (ex. Hawaii.)

21056 to 21057.

From Aburi, Gold Coast, British West Africa. Presented by Prof. A. E. Evans, Acting Director of Agriculture, through Mr. O. W. Barrett, June 17, 1907.

21056. SIDEROXYLON DULCIFICUM. Miraculous tree.

21057. MIMUSOPS DJAVE. Baco nut.

"Probably *M. djave,* 'baco nut.' Seed yields 40 per cent of oil; timber exported as West African mahogany." (*Evans.*)

21058. ANONA CHERIMOLIA. Cherimoyer.

From Lima, Peru. Presented by Mr. T. F. Sedgwick, director, Estacion Experimental, June 19, 1907.

21059. EUGENIA JAMBOS. Rose apple.

From Mayaguez, Porto Rico. Presented by Mr. M. J. Iorns, horticulturist, Agricultural Experiment Station, through Mr. O. W. Barrett, June 18, 1907.

21060. VICIA VILLOSA. Hairy vetch.

From Riga, Russia. Received through Messrs. Vollmer & Co., June 20, 1907.

"This seed is exclusively grown in the Riga district, or, more correctly, in the Courland and Lithuanian provinces here, where we have experienced during the last winter a cold of 25° R. below zero, and we think that in New England scarcely any lower temperature will prevail in winter. This vetch is sown with us in autumn. We have inquired anew of the farmers and find that no hairy vetch seed is sown in the spring here. They call it winter vetch and sow it in the fall, using winter rye as a nurse crop. The northernmost point in Russia where the hairy vetch is grown is the Petersburg district, but the climatic conditions there do not allow it to mature, and large quantities of the seed are shipped there every year from here.

"An interesting point is that the Scandinavian countries are importing large quantities of this seed, much of it going to Copenhagen.

"This seed was grown on some large estates in Courland and adjoining Lithuanian districts." (*Vollmer & Co.*)

21061. VIGNA UNGUICULATA. Cowpea.

From Village, Ark. Presented by Mr. Jas. Moody, R. No. 1, through Prof. C. V. Piper, June 20, 1907.

"An ideal pea for hay, as the vines are slender." (*Moody.*)

21062 to 21086.

From Manchuria. Received through Mr. Frank N. Meyer, agricultural explorer, June 21, 1907.

21062. CANNABIS SATIVA. **Hemp.**

From Wu-lu-kai, Manchuria. "(No. 703a, Jan. 3, 1907.) Chinese name *Shem-ma.* A variety of hemp growing on the rather sandy lands around here. It has thin stalks and produces a strong kind of hemp, though not quite white of fiber." (*Meyer.*)

21063. CANNABIS SATIVA. **Hemp.**

From Wu-li-pu, Manchuria. "(No. 711a, Dec. 27, 1907.) Said to be a strong, good hemp." (*Meyer.*)

21064. FAGOPYRUM ESCULENTUM. **Buckwheat.**

From Tchwang-yang, Manchuria. "(No. 702a, Jan. 9, 1907.) Chinese name *Tchau mi.* It is used to make cakes and a blackish kind of bread." (*Meyer.*)

21065. MALUS sp. **Crab apple.**

From north Kirin, Manchuria. "(No. 716a, Jan. 2, 1907.) For remarks see Nos. 568a, 569a, and 570a (S. P. I. Nos. 20339 to 20341)." (*Meyer.*)

21066. ORYZA SATIVA. **Rice.**

From Wu-li-pu, Manchuria. "(No. 704a, Dec. 27, 1906.) Dry-land rice. Chinese name *Pai tau tze.* A very good variety of white rice, being eaten as a staple food by the people of the northern part of Manchuria; said to be a trifle soft when boiled. It is sown in rows 1¼ feet apart and loves a moisture-retaining soil." (*Meyer.*)

21067. ORYZA SATIVA. **Rice.**

From Scha-li-ho, Manchuria. "(No. 705a, Jan. 8, 1907.) Dry-land rice; said to be a better variety than the preceding number (No. 704a, S. P. I. No. 21066), but seems to be about the same." (*Meyer.*)

21068. ORYZA SATIVA. **Rice.**

From Kai-yuan, Manchuria. "(No. 706a, Jan. 14, 1907.) Dry-land rice. Chinese name *Neu mo tau.* It is a very good, hard variety, forming a staple food for the people, and seems to be able to grow in drier localities than the preceding numbers (Nos. 704a and 705a, S. P. I. Nos. 21066 and 21067). It seems to be a valuable addition to the crops of the northern United States." (*Meyer.*)

21069. ORYZA SATIVA. **Rice.**

From Tiëling, Manchuria. "(No. 707a, Jan. 17, 1907.) Dry-land rice; the same variety as the preceding number (No. 706a, S. P. I. No. 21068), but having somewhat redder husks; otherwise the same remarks apply to it." (*Meyer.*)

21070. POLYGONUM TINCTORIUM.

From Wu-li-pu, Manchuria. "(No. 708a, Dec. 27, 1906.) Chinese name *Diën.* An annual herb, the young stems and leaves of which are used to produce an indigo, which supplies the dye for the blue clothes seen all over north China. Seeds are sown in rows, generally 1¼ feet apart." (*Meyer.*)

21071. TRITICUM VULGARE. **Wheat.**

From Tchwang-yang, Manchuria. "(No. 700a, Jan. 9, 1907.) Summer wheat. The best variety of hard wheat of the neighborhood." (*Meyer.*)

21072. TRITICUM VULGARE. **Wheat.**

From Wu-lu-kai, Manchuria. "(No. 701a, Jan. 3, 1907.) Summer wheat. A medium hard variety of wheat grown all over the country around Wu-lu-kai." (*Meyer.*)

21062 to 21086—Continued.

21073. CHAETOCHLOA ITALICA. **Siberian millet.**

From Wu-li-pu, Manchuria. "(No. 696a, Dec. 27, 1906.) A small red millet. Chinese name *Hong nien ko.* Used, after being hulled, as food, being boiled with water into a kind of porridge. Sown on rather light soils, rows 1½ feet apart." (*Meyer.*)

21074. PANICUM MILIACEUM. **Broom-corn millet.**

From Wu-li-pu, Manchuria. "(No. 697a, Dec. 27, 1906.) A white-seeded millet. Chinese name *Gwang mi.* The seeds are used, after being hulled, as food, being boiled into a stiff porridge; also used for broom making, the heads being very drooping. It is sown in rows 2 to 2½ feet apart on not too heavy soils." (*Meyer.*)

21075. PANICUM CRUS-GALLI. **Barnyard millet.**

From Tchwang-yang, Manchuria. "(No. 698a, Jan. 9, 1907.) A grayish millet; Chinese name *Pai tse.* It is used, after being hulled, in the boiled state as a food for the poorer classes. Grown on low-lying rich land, and makes an enormous number of stalks; sown in rows 2½ to 3 feet apart. Seeds sent before under Nos. 50a and 592a (S. P. I. Nos. 17901 and 20363." (*Meyer.*)

21076. CHAETOCHLOA ITALICA. **Siberian millet.**

From Wu-lu-kai, Manchuria. "(No. 699a, Jan. 3, 1907.) A small white millet. Chinese name *Pai shau mi tse.* This variety is considered the very best of all the small millets in Manchuria. It is boiled and eaten as a porridge after being hulled. Sown on sandy lands in rows 1½ feet apart." (*Meyer.*)

21077. ANDROPOGON SORGHUM. **Sorghum.**

From Mukden, Manchuria. "(No. 717a, Jan. 23, 1907.) A white sorghum; Chinese name *Pai kau liang.* The best variety of white millet grown around Mukden. It is used as a food in the form of porridge, small cakes, and also served often as vermicelli. It commands one-third more money than the brown-colored millets do." (*Meyer.*)

21078. ANDROPOGON SORGHUM. **Sorghum.**

From Mukden, Manchuria. "(No. 718a, Jan. 23, 1907.) A brown-colored sorghum; Chinese name *Kau liang.* The best variety of brown millet grown around Mukden. It is used as food in the shape of porridge and cakes; also an important food for the domestic animals." (*Meyer.*)

21079. GLYCINE HISPIDA. **Soy bean.**

From Tiëling, Manchuria. "(No. 693a, Jan. 18, 1907.) A light green soy bean; Chinese name *Shing toa.* This bean is used to produce bean oil and bean cake. The variety is very rarely seen." (*Meyer.*)

21080. GLYCINE HISPIDA. **Soy bean.**

From Tiëling, Manchuria. "(No. 694a, Jan. 18, 1907.) A dark green soy bean; Chinese name *Li dau shing.* This bean is used as a vegetable throughout the winter months, being eaten boiled after it has sprouted slightly. This variety is the most expensive of all the soy beans and is eaten by the better classes of Chinese; sent also from Harbin under No. 675a (S. P. I. No. 20854)." (*Meyer.*)

21081. PHASEOLUS ANGULARIS. **Adzuki bean.**

From Tiëling, Manchuria. "(No. 689a, Jan. 17, 1907.) A small grayish bean; Chinese name *Pei sha toa;* used as food, being eaten boiled with rice or millets." (*Meyer.*)

21062 to 21086—Continued.

21082. Phaseolus angularis. **Adzuki bean.**

From Tiëling, Manchuria. "(No. 690a, Jan. 17, 1907.) A small red bean; Chinese name *Hong sha toa.* It is used as food, being eaten boiled with rice or different millets, and also ground up with sugar as a confection in small millet cakes." (*Meyer.*)

21083. Phaseolus angularis. **Adzuki bean.**

From Tiëling, Manchuria. "(No. 691a, Jan. 18, 1907.) A small red bean; Chinese name *Hong sha toa.* A larger variety than the preceding number (No. 690a, S. P. I. No. 21082); otherwise the same remarks apply to it." (*Meyer.*)

21084. Phaseolus angularis. **Adzuki bean.**

From Tiëling, Manchuria. "(No. 692a, Jan. 18, 1907.) A brown, white-spotted bean; Chinese name *Gwa sho toa;* used as food, being boiled with rice or millets." (*Meyer.*)

21085. Vigna unguiculata. **Cowpea.**

From Tchang-yang, Manchuria. "(No. 695a, Jan. 9, 1907.) A small speckled bean and a very rare variety. It is used as food in soup, and also boiled with rice and different millets." (*Meyer.*)

21086. Phaseolus radiatus. **Mung bean.**

From Mukden, Manchuria. "(No. 719a, Jan. 23, 1907.) Chinese name *Lu toa.* This bean is used to make bean vermicelli and as a vegetable after having sprouted. As such it deserves greatly to be tried. As a cold salad with vinegar, salt, etc., or served hot with small pieces of fried pork or mixed with vermicelli, it is exceedingly palatable and relished by foreigners and Chinese alike." (*Meyer.*)

21092. Phoenix dactylifera. **Date.**

From Marseille, France. Purchased from Champagne Brothers through Mr. W. T. Swingle. Received June 22, 1907.

"*Deglet Noor.* To be planted in the southern part of California for experimental purposes." (*Swingle.*)

21094. Mucuna sp.

From India. Presented by Vaughan's Seed Store, Chicago, Ill., June 25, 1907.

"This spotted bean is very productive. It grows wild and the seed is eaten. It is a pole bean and needs a long season, being planted in June and gathered in December. It is not of good flavor. The natives cook it with the flower of the mohul (*Bassia latifolia*), which is quite sweet; yields perhaps a quart and a gill to the vine; may be of value as food for stock." (*From letter of one of Vaughan's correspondents.*)

21095. Beta trigyna.

From Strassburg, Germany. Presented by the director of the Botanic Gardens June 24, 1907.

Introduced for the beet-breeding work of this Department under Mr. Rittue's direct charge.

21096 to 21125. Phoenix dactylifera. **Date.**

From El Oued, Algeria, North Africa. Received from Captain Bussy, chief of the Bureau Arabe, through Mr. T. H. Kearney, June 27, 1907.

"*Tafazween.* One offshoot of each of the above numbers was received. Each shoot was given a separate number, as it was thought possible that different varieties might be obtained and that it would be advisable to trace their development separately." (*Swingle.*)

21126 to 21185. PHOENIX DACTYLIFERA. **Date.**

From Biskra, Algeria, North Africa. Received from Mr. Colombo, sr., through Mr. W. T. Swingle. Received June 27, 1907.

21126 to 21135. *M'Kentishee Degla.* **21147 to 21185.** *Thooree.*

21136 to 21146. *Horra.*

Offshoots numbered separately, as under numbers 21096 to 21125.

21186. VICIA FABA. **Broad bean.**

From Shanghai, China. Presented by Dr. S. P. Barchet, American deputy consul-general, through Prof. C. V. Piper, June 3, 1907.

O'deo Shai.

21188. CHAMAEDOREA sp. **Palm.**

From El Cacao, Trece Aguas, Alta Verapaz, Guatemala. Received through Mr. G. P. Goll, of the Bureau of Plant Industry, July 1, 1907.

"A dwarf palm growing at an altitude of 1,200 feet; introduced for its ornamental value, as it withstands the dry heat of dwellings better than any other variety and is the most graceful of the smaller ones." (*Goll.*)

21190. COLOCASIA sp. **Taro.**

From Lima, Peru. Presented by Mr. T. F. Sedgwick, director, Estacion Experimental, through Mr. O. W. Barrett. Received July 3, 1907.

"So far as I can learn, this variety of taro is the only kind eaten here, and even this is not very extensively used." (*Sedgwick.*)

21194. CYPERUS EXALTATUS. **Samar.**

From Cairo, Egypt. Received from Mr. George P. Foaden, secretary, Khedivial Agricultural Society, July 2, 1907.

"This is a sedge which is grown in Egypt on irrigated lands, particularly on lands which are being flooded in order to wash out the salt. Its stems grow to a height of 6 or 8 feet and are split by the manufacturers and made into rather rough, but effective, mats, which they use in their houses. Introduced for the purpose of experiments in the manufacture of floor matting." (*Fairchild.*)

21198. ARACHIS HYPOGAEA. **Peanut.**

From Aburi, Gold Coast, British West Africa. Presented by Prof. A. E. Evans, Acting Director of Agriculture. Received July 5, 1907.

"So far this is the only variety grown in this colony. It is known as *Nkate* or *Nkatie* and is largely used as an article of food by the natives. It is exported from this colony, chiefly to France. The Gambia exports this nut in very large quantities, chiefly to France." (*Evans.*)

21199 to 21201. IPOMOEA BATATAS. **Sweet potato.**

From Bridgetown, Barbados, British West Indies. Presented by Mr. John R. Bovell, superintendent, Agricultural Department, through Mr. Rudolph Anstead, agricultural superintendent, Botanic Station, St. George's, Grenada, British West Indies, and Sir Daniel Morris, the Commissioner of Agriculture for the West Indies, at the request of Mr. O. W. Barrett. Received July 5, 1907.

"The varieties of sweet potatoes sent you are those that give a good yield all over the island and are free from disease. The *Trinidadian* is a potato that keeps well." (*Bovell.*)

21199. *Trinidadian.* **21201.** *White Sealy.*

21200. *Johns.*

21202. JUNCUS EFFUSUS. **Rush.**

From Webster, Tex. Presented by Mr. K. Saibara, through Mr. John H. Tull. Received July 8, 1907.

Secured for experiments in matting-rush investigations.

21203. KIGELIA PINNATA. **Sausage tree.**

From Cairo, Egypt. Presented by Mr. George P. Foaden, secretary, Khedivial Agricultural Society. Received July 9, 1907.

"A good shade tree having exceedingly stiff foliage; the leaves are rough, like sandpaper." (*Fairchild.*)

21204. NEPHELIUM LITCHI. **Litchi.**

From Hinghua, Fukien, China. Secured by Rev. William N. Brewster. Received at Seattle, October 18, 1906.

"*Soil.*—The trees flourish best in a soft, moist, black soil; alluvium seems best.

"*Location.*—Near by or on the bank of a stream or irrigation canal is best, though this is not essential. Where there is no stream the trees should be watered so frequently that the ground below the surface is always moist; about twice a week when rain is not abundant should be enough. After the young trees are well started, about 2 or 3 years old, the irrigation may be less frequent.

"*Frost* can not be borne at all. They will not flourish north of the frost line. They are particularly sensitive to cold while young. It is the custom here to wrap the trees with straw to protect them from the cold. After the trees are 5 or 6 years old they are less sensitive, and it takes quite a heavy frost to injure them.

"*Pruning* is not practiced with the litchi. The leaves, branches, and blossoms are allowed to grow without molestation. It is notable that the companion tree, the 'lingeng' (*Nephelium longanum*), is treated in exactly the opposite way by the same Chinese cultivators. The only pruning seems to be that required to prevent the young tree from bearing until it is 5 or 6 years old. This is very important—especially so with the 'lingeng.'

"*Propagation* is accomplished by tying a ball of earth about 8 inches in diameter to a joint on a branch of a good tree. This is done in February or March. An earthen vessel with the bottom broken out is fastened to the top of the ball, and this is filled with water almost daily. In about eight months the branch may be cut off and planted in the manner above described. The young tree should be planted in soil similar to that of the earth ball.

"*Blossoms* appear in April. They are very small and make very little change in the appearance of the tree. The blossoms fall off or thin themselves out without trouble to the horticulturist. The fruit ripens in July. It is a bright red color when ripe, and at a little distance a stranger would mistake it for a strawberry, as it is like that fruit in color, shape, and size. However, it has a rough rind, or thick skin, which breaks off easily. The meat is white, slightly tart, and very delicious. Who can describe a taste?

"The *seeds* are both large and small on the same tree. The small pit, of course, is much more desirable, but so far the Chinese do not seem to know how to develop uniformly small-seeded fruit. They claim that the blossoms that come out first develop small-seeded fruit, and the later ones are large. However, there are trees which bear many small-seeded litchis and others that are uniformly the opposite. They think the original tree and the soil have much to do with this.

"*Grafting* is not practiced with the litchi so far as I can learn. This is also in marked contrast to the methods used in 'lingeng' culture.

"*Fertilization* is important. Guano is probably as good as anything. The Chinese use night soil. They dig a shallow trench around the tree at the end of the roots and fill it with liquid manure of some sort. This is done about once in three months.

"*Enemies.*—The litchi has enemies, as all good things do. There is a worm that makes a ring around the trunk under the bark. When the circle is complete the tree dies; but the bark is broken by it, and by careful watching this

21204—Continued.

can be prevented before the worm does serious harm. There is also a sort of mildew upon the leaves in certain years that does much harm, and the Chinese do not seem to have any way of dealing with it. If these do not get into America with the imported plants they may never trouble you there at all." (*Brewster.*)

21205. GALPHIMIA BRASILIENSIS.

From Piracicaba, São Paulo, Brazil. Presented by Mr. Georg H. Weigt, director of the Botanic Gardens. Received July 23, 1907.

"The plant out here proves to be of great value in garden planting." (*Weigt.*)

21209 and 21210. CITRUS AURANTIUM. **Orange.**

From Cape Verde, Africa. Presented by Mr. W. Crewdson, Southside, St. Leonards-on-Sea, England. Received July 16, 1907.

21209. Cuttings. **21210.** Seed.

"This is a delicious variety of green orange of large size. Said to be generally propagated from seed." (*Crewdson.*)

21213. BOUGAINVILLEA sp.

From Santiago de las Vegas, Cuba. Presented by Prof. C. F. Austin, chief, Department of Horticulture, Estación Central Agronómica. Received July 17, 1907.

"This form has a small white or yellowish flower. It is found in this country in the old gardens and patios. It is the purple part of the flower of this form that makes it a very showy ornamental for arbors and such places." (*Austin.*)

21214. CASTILLA ELASTICA (?). **Rubber.**

From Zent, Costa Rica. Presented by Mr. E. Pilgrims, United Fruit Company, Stirling Farm. Received July 18, 1907.

21215. CAREX TRIANGULARIS. **Sedge.**

From Pierce, Tex. Received through Mr. F. W. Clarke, of this Department, July 23, 1907.

Plants for use in the matting-rush experiments.

21218. GLYCYRRHIZA GLABRA. **Licorice.**

From Teheran, Persia. Secured by Mr. John Tyler, United States vice consul general. Received July 24, 1907.

For the experiments of Dr. Rodney H. True in the culture of licorice in America.

21219 to 21224.

From Barberton, Transvaal. Secured from Mr. George Thorncroft, through Mr. J. Burtt Davy, July 25, 1907.

21219. GLADIOLUS sp.
21220. GLADIOLUS sp.
21221. WATSONIA DENSIFLORA.
21222. TRITONIA sp.
21223. ANDROCYMBIUM MELANTUIOIDES.
21224. CEROPEGIA sp.

21226. ANONA CHERIMOLIA (?). **Cherimoyer.**

From Funchal, Madeira. Presented by Mr. Charles O. L. Power. Received July 29, 1907.

"Unnamed variety from tree having especially good record." (*Fairchild.*)

21227. Amygdalus davidiana. **Peach.**

From Tientsin, China. Received through Mr. Frank N. Meyer, agricultural explorer, July, 1907, at the Plant Introduction Garden, Chico, Cal.

"(No. 728a, June 12, 1907.) Seeds to be utilized as a stock for peaches. Thrives well on high, dry soils and is apparently very resistant to disease, Seeds sent in 1905 under No. 9a (S. P. I. No. 18262), from Peking." (*Meyer.*)

21228 to 21230.

From Shanghai, China. Received through Mr. Frank N. Meyer, agricultural explorer, July 19, 1907.

21228. Raphanus sativus. **Radish.**

From Peking, China. "(No. 729a, June 3, 1907.) A long red radish; Chinese name *Hong laba.* A very good, large variety of a radish of a very oblong shape and bright red color; quite juicy when eaten fresh. It is eaten stewed, raw, or sliced and pickled; sown as soon as the frost leaves the ground." (*Meyer.*)

21229. Brassica pe-tsai. **Pe-tsai cabbage.**

From Peking, China. "(No. 730a, June 3, 1907.) Chinese name *Pai tsai.* Said to be a late, large, solid-headed, long cabbage of good keeping qualities. It requires, like all the Chinese varieties of cabbage, a light, well-worked soil with abundant moisture." (*Meyer.*)

21230. Foeniculum dulce. **Sweet fennel.**

From Peking, China. "(No. 731a, June 3, 1907.) Chinese name *Huin shang tsai.* A very early vegetable grown by the Chinese as a flavoring herb. They use it in soups, in sauces, and with meat and fish; it is very sweet. The seed can be sown on sandy, moist situations as soon as frost leaves the ground; well worth a trial." (*Meyer.*)

21231 to 21234.

From Mongolia. Received through Hon. W. W. Rockhill, United States minister, Peking, China, July 29, 1907, on a memorandum presented by Mr. W. T. Swingle, November 26, 1906.

The following notations as to where the seed was procured were taken from bags and tags that came with the seed:

21231. Avena sativa. **Oats.**

Notation on tag: Oats gathered at Eul-cheu-seu-ts'ing-ti, in the valley of the upper Hoang-ho, two days' journey west of Koei-hoa-t'cheng.

Notation on bag: Oats gathered in the valley of the Yellow River, 260 li west of Blueville (Ville-Bleue).

21232. Medicago sativa. **Alfalfa.**

Notation on tag: Lucern with blue flowers from Ning-t'iao-leang; locality four days' journey southeast of Yu-lin-fou.

21233. Avena sativa. **Oats.**

Notation on tag: Oats of Mao-min-ngau. (From a very cold section.)

21234. Avena sativa. **Oats.**

Notation on tag: Oats of Ning-t'iao-leang. (Locality four days' journey southeast of Yu-lin-fou.)

"Since the locality in which we live (Hadjoo, Mao Ming-ngan) is relatively cold, oats are sown here during the first days of May. They take 120 days to mature. When the season is not dry they grow exceedingly well, by preference in soil worked in the spring of the sowing, contrary to wheat, which gives the best yield in soil worked in the autumn

21231 to 21234—Continued.

previous. The great enemy of oats here is the smut, or black rust. The Chinese combat this in this way:

"They put the oats into a small, well-heated kettle together with 4 ounces of juniper (chaotsiou) to the measure (teou) of 18 t'oungs (say, 6 t'oungs more to the teou than the Peking teou). In order to mix the two thoroughly the kettle is shaken smartly after the manner of winnowing, and then permitted to rest for a few moments.

"Without this precaution smut works havoc here. Because of the scarcity of oats in this region during the past year (the harvest has failed for several years because of drought) I got my seed from the Siao-noor. My harvest of oats succeeded badly. I think the reason of this is to be found in the climate, which is milder than that of Siao-noor. My harvest resulted in a yield which was half smut. Those who used less juniper in the preparation of the seed obtained a yield which was a little more than a third good grain. We notice here that the oats sown in fine weather give a yield very different from those sown in cold and cloudy weather; hence, the sowing should be done on fine, sunny days.

"As to the general features of our district of Moa Ming-ngan, there is a succession of undulating plains, interspersed with occasional rocky mountains. The soil is stony and in working it the plows often break. Our region is at a much greater elevation than the town of Pao-t'ou; from that point there is a two days' journey, rising continually all the way." (*François de Boeck, missionary.*)

"NOTE.—The t'oung (or t'ung) referred to by the writer seems to be the official tube, kept in the magistrate's yamen, with which to test measures of capacity.

"All efforts to secure uniform weights and measures in China have thus far proved failures. Every county seems to have its own peck and pound. The teou (or tou) mentioned is that commonly called the "peck" by foreigners. It varies in various districts from 4 liters or a little more to 42 liters. The Peking liter, to which reference is made, is perhaps that used in measuring the tribute rice, which contains $\frac{1}{1}\frac{0}{1}$ liter, or about 630.5 cubic inches—that is, about 1.17 pecks." (*Rockhill.*)

21235. (Undetermined.)

From Victoria, Kamerun, West Africa. Presented by Dr. A. Weberbauer. Received July 29, 1907.

Sent in as *Sideroxylon dulcificum.* According to Prof. C. F. Wheeler it is something different.

21236. CEPHALOSTACHYUM PERGRACILE.

From St. Symphorien, Belgium. Presented by Mr. Jean Houzeau de Lehaie. Received July 27, 1907.

"This plant is found growing in the Singhbhûm forests of Chota Nagpore; Sibságar lakhimpur and Naga Hills in Assam; all over Burma, where very common and often gregarious. A deciduous, arboreous, tufted bamboo, with glaucous-green culms 30 to 40 feet high, 2 to 3 inches in diameter, and rather thin walled, the walls usually about one-half inch thick. It is one of the chief bamboos of Burma, and one of those most frequently found in association with teak. It flowers usually gregariously, but also sporadically, though when thus flowering it rarely produces good seed, following in this the example of the male bamboo. The culms are used in building and mat making, and rice is often cooked in the joints to be easily carried on a journey. In Assam it is used for basket work." (*Gamble, Manual of Indian Timbers.*)

21237 to 21241.

From Peking, China. Received through Mr. E. H. Wilson, of the Arnold Arboretum, Jamaica Plain, Mass., in cooperation with this office. Received July 29, 1907.

Although these seeds came via Peking they were probably collected near Ichang, Hupeh, where Mr. Wilson had his headquarters.

21237 to 21241—Continued.

21237. RUBUS ROSAEFOLIUS.

"(No. 2, June 15, 1907.) An erect-growing bramble, 2 to 6 feet high, leaves pinnate. Stems square, green, reddish at base. Flowers white, 1 to 1¼ inches across, borne singly and laterally. Fruits of good size, globular, red, easily separated from receptacle; flavor pleasantly sweet. Common between 1,500 feet and 3,500 feet in open, sunny thickets and grassy areas. Probably hardy in the vicinity of Washington. Possibly useful to hybridists. Its large, white flowers are very ornamental." (*Wilson.*)

21238. RUBUS PLAYFAIRII.

"(No. 4, June 15, 1907.) A rambling bramble with long scandent branches. Leaves pedately 3 to 5 foliate, dun-colored below. Flowers insignificant, borne in long panicles at ends of shoots. Fruits small, very dark red, edible but of no particular merit. Abundant between 100 feet and 2,500 feet in thickets. Probably hardy around Washington. Possibly useful to hybridists on account of its free-fruiting proclivities. In foliage and habit ornamental." (*Wilson.*)

21239. RUBUS CORCHORIFOLIUS.

"(No. 15, June 15, 1907.) An erect-growing bramble. Stems arching, leaves on one-year-old shoots trifid, on two-year-old shoots simple, elliptic. Flowers white, insignificant, solitary, and lateral. Fruits raspberry-red, somewhat pointed, of good size, sweet, vinous, and of excellent flavor, easily articulating, but adhering to receptacle. Common 100 feet to 5,000 feet in open thickets and more especially abandoned cultivated areas. One of the finest of the Chinese Rubi from the point of view of its fruit. Hardy from New York south and possibly farther north. A fruit with possibilities in the hands of hybridists. Its disadvantage is that the receptacle, though small, firmly adheres to the fruit." (*Wilson.*)

21240. RUBUS CORCHORIFOLIUS.

"(No. 15a, June 15, 1907.) This is in all probability the same as No. 15 (S. P. I. No. 21239), but the fruits were all purchased in a mountain village, altitude 3,000 feet." (*Wilson.*)

21241. ARUNDINARIA WILSONI (?) **Bamboo.**

"(No. 30, June 19, 1907.) An erect-growing bamboo, forming impassable thickets on sparsely tree clad mountains between 500 feet and 8,500 feet. Culms thin, dull green, 2 feet to 10 feet high. Leaves 5 to 8 inches long, one-half inch broad. Flowers in panicles. Only flowering culms die. Grain eaten locally by peasants when obtainable. The periods of flowering are erratic as far as I can find out. Hardy and ornamental. Culms useful for paper making." (*Wilson.*)

21244. MACADAMIA TERNIFOLIA. Queensland nut.

From Burringbar, Tweed River, New South Wales, Australia. Presented by Mr. B. Harrison. Received July 13, 1907.

(See S. P. I. No. 18382 for description.)

21245. NEPHELIUM GLABRUM.

From Manila, P. I. Presented by Mr. Wm. S. Lyon, horticulturist, Bureau of Agriculture. Received July 19, 1907.

"One of the finest fruits in the Philippines." (*Lyon.*)

21246. BASSIA LATIFOLIA. Mahwah tree.

From Sibpur, Calcutta, India. Presented by Prof. A. T. Gage, superintendent of the Royal Botanic Garden, through Mr. David Fairchild. Received July 31, 1907.

The Mahwah tree furnishes a hard and strong timber used for the wheels of carriages, etc. The flowers are sweet tasting and are eaten raw; the Beehls

21246—Continued.

are stated to collect and dry them as a staple article of food. The flowers are also used in the distillation of an ardent spirit. The seeds yield an oil used by the poorer classes for lamps, in the manufacture of soap, and for culinary purposes. (*Adapted from Gibson.*)

21248. MACADAMIA TERNIFOLIA. **Queensland nut.**

From Sydney, New South Wales. Received from Messrs. Anderson & Co., at the Plant Introduction Garden, Chico, Cal., August, 1906.

(See S. P. I. No. 18382 for description.)

21249. MACADAMIA TERNIFOLIA. **Queensland nut.**

From Brisbane, Australia. Received from Prof. F. M. Bailey, colonial botanist, Department of Agriculture, at the Plant Introduction Garden, Chico, Cal., April 26, 1907.

(See S. P. I. No. 18382 for description.)

21250. CASTANOPSIS CHRYSOPHYLLA.

From Willits, Cal. Secured by Mr. Edward Goucher, of the Plant Introduction Garden, Chico, Cal., October 30, 1906.

21251. JUNCUS EFFUSUS. **Matting rush.**

From Okayama, Japan. Received through Mr. John H. Tull, special agent, at the Plant Introduction Garden, Chico, Cal., October, 1906.

"A semiaquatic rush, found growing wild in the Temperate Zone almost all around the world. Some forms grow to a height of 4 or 5 feet and are rather coarse and stiff in structure, while other forms are smaller in diameter and only 1 or 2 feet in height.

"In the southern part of the main island of Japan, principally in Bingo province, and in many parts of northern China and Korea it is cultivated in the paddy fields for the purpose of making floor mattings of various kinds. The form used over there would seldom exceed 2 feet in height if planted wild, but when cultivated is often found 5 feet in height, while at least 33 per cent of the plants are generally 4 feet or over in height.

"The plant is a perennial and always propagated by root division, as it can be multiplied rapidly by this means.

"As it is grown in the same fields in which rice is grown, the crop must be planted, grown, and harvested within six months in order that a crop of rice may be produced on the same land in the same year.

"After the rice is harvested in the fall the land is prepared and immediately planted with small clumps of rush that have been subdivided from large clumps and saved for stock plants from the last year's crop. These are planted by hand in the soft mud about 8 or 10 inches apart each way and are immediately flooded with water to a depth of about 2 inches. The crop is heavily fertilized with night soil, manures of various kinds, and commercial fertilizers, the principal forms being night soil and bean cake, the latter being imported from China. At harvest time—generally July—the stems are cut by hand with a sickle and tied into bundles about a foot in diameter. As soon as cut, while the stems are still green, they are completely covered with a thin clay mixture by dipping them into a thick clayey solution produced by mixing a white clay gotten from the near-by mountains and water. After dipping they are spread out in the hot sun to cure, the clay on the stems preventing them from turning and causing them to cure to a uniform color. After curing, which takes about two days of hot sunshine, they are gathered into bundles and stored in an open airy shed to remain until the farmer has planted his rice crop for that season. After that they are assorted into proper lengths and are ready to be woven into mattings, hats, small mats, etc.

"These roots were collected in and around the towns of Onomechi and Okayama, in Bingo and Bizen provinces. They were shipped in bamboo crates packed in sphagnum moss. They were packed about September 20, shipped on October 2, and unpacked about a month later. There were possibly 35,000 good roots saved, though by dividing the root clumps any number of plants desired could be had." (*Tull.*)

21252. CYPERUS TEGETIFORMIS. **Matting sedge.**

From Beppu, Kiushiu Island, Japan. Received through Mr. John H. Tull, special agent, at the Plant Introduction Garden, Chico, Cal., January 4, 1907.

"A semiaquatic perennial sedge found wild in warmer parts of the Temperate Zone in Asia.

"In south middle China and in the island of Kiushiu, Japan, it is cultivated for its long stems, of which different grades of matting are made.

"The plants are grown in the low paddy fields where rice is grown and are generally grown in several inches of water, though by planting the roots in low moist land and heavily mulching them with rice straw to preserve moisture and prevent the weeds from crowding them out a very successful crop can be produced. These roots are preserved the same as the *Juncus effusus* roots, by saving them from the last year's crop, and when ready to plant are divided into small clumps, each clump containing several 'eyes.'

"They are planted about 5 inches apart each way and are then flooded with water to a height of about 2 inches. The fertilizer is put on very heavy, being divided into several applications during the growing season.

"In about five months after planting the stems are ready to harvest, being at that time from 4 to 6 feet high. These stems are harvested green by hand with a sickle and tied into bundles. In the evening the family all get busy and these stems are all split longitudinally several times by drawing through them a taut, fine wire.

"After splitting they are exposed three successive days to the hot sunshine, which cures them.

"They are then cut to the proper length, 3½ feet, for weaving matting a yard wide.

"About 90 large boxes of these roots were collected near Beppu, Bungo province, Kiushiu, Japan. They were packed about November 15 and shipped via both tram and boat to Nagasaki, and then to San Francisco.

"It was estimated that about 80,000 roots were alive on January 8, 1907, when unpacked, but by making smaller divisions many more plants could have been produced, as they are multiplied by root division." (*Tull.*)

21253. PYRUS SINENSIS. **Pear.**

From Peking, China. Received through Mr. Frank N. Meyer, agricultural explorer, at the Plant Introduction Garden, Chico, Cal., February 20, 1906.

"(No. 99a.) Seeds of the most remarkable pear of North China. Looks and smells like a quince, but has melting meat and tastes very good. Chinese name *Ya kwam li.*" (*Meyer.*)

21254. PYRUS SINENSIS. **Pear.**

From China. Received through Mr. Frank N. Meyer, agricultural explorer, at the Plant Introduction Garden, Chico, Cal., February 20, 1906.

"(No. 127a.) Pear seeds from everywhere. In all probability some interesting varieties will appear from these seeds." (*Meyer.*)

21255. NANDINA DOMESTICA.

From Hanchau, China. Received through Mr. Frank N. Meyer, at the Plant Introduction Garden, Chico, Cal., April 22, 1906.

"(No. 224a, Mar. 5, 1906.) Seeds of 'heavenly bamboo.' An evergreen shrub bearing bunches of beautiful scarlet-colored berries in winter. The Chinese use the stalks with berries for house decoration at the Chinese New Year, for which purpose they are splendidly adapted." (*Meyer.*)

21256. CALLISTEPHUS HORTENSIS. **China aster.**

From Wu-tai-shan, Shansi, China. Received through Mr. Frank N. Meyer, agricultural explorer, at the Plant Introduction Garden Chico, Cal., April 22, 1907.

"(No. 725a.) Seeds of an annual flower called *Hsi hua.* Obtained from a priest at the Ta Yuen Sze temple at Wu-tai-shan." (*Meyer.*)

21257. Anona sp. (?).

From Tula, Vera Cruz, Mexico. Presented by Mr. Edward Everest, through Mr. O. W. Barrett. Received August 7, 1907.

"*Aguatoso*, a fruit which resembles the cherimoyer in appearance." (*Everest.*)

21258 to 21260. Phoenix dactylifera. **Date.**

From Bagdad, Arabia. Received through Mr. William C. Magelssen, American consul, August 9, 1907.

21258. *Ascherasi.*

21259. *Zehedi.*

21260. *Maktum.*

Date seeds from which to propagate seedling date orchards.

21261. Xanthorrhoea tateana. **Australian grass-tree.**

From Melbourne, Australia. Presented by Mr. W. R. Guilfoyle, director, Botanic Gardens, through Mr. David Fairchild. Received August 6, 1907.

21262. Lagenaria vulgaris. **Gourd.**

From Columbia, Isle of Pines. Presented by Dr. F. R. Ramsdell. Received August 12, 1907.

"*Upo.* Grown from seeds procured from Mr. W. S. Lyon, Manila Bureau of Agriculture, who says fruits are to be eaten green, like summer squash. The one from which this seed was procured was 2 feet long, of a beautiful white color, smooth, and was tender until full grown. Instead of drying up like a gourd the meat, 2 inches thick, retained its consistency and was cooked and eaten weeks after it was ripe. It was not very good ripe, being very like watermelon rind, but when preserved was found to be very nice. It should be eaten when nearly grown but still tender." (*Ramsdell.*)

21263 to 21266. Colocasia antiquorum.

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture. Received August 13, 1907.

A collection of four varieties, marked, respectively, Nos. 1, 2, 3, and 4: 1 and 2, *Tales ketan;* 3 and 4, *Tales belang.*

21267 to 21268.

From Poole, Trinidad. Received through Mr. O. W. Barrett, Port of Spain, Trinidad, August 15, 1907.

21267. Dioscorea sp. **Yam.**

"A cultivated variety apparently distinct from any now in the collection of the Department and said to be of excellent quality." (*Barrett.*)

21268. Brownea coccinea (?).

"A tree of the virgin forest; flowers large, red." (*Barrett.*)

21276. Garcinia mangostana. **Mangosteen.**

From Peradeniya, Ceylon. Received from Mr. H. F. MacMillan, Royal Botanic Gardens, Peradeniya, Ceylon, August 22, 1907.

"Seed of the well-known delicious fruit tree of the eastern Tropics." (*Fairchild.*)

21277. Gymnocladus chinensis.

From Ning-po, China. Received through Mr. Frank N. Meyer, agricultural explorer, August 24, 1907.

"(No. 738a, July 5, 1907.) One of the soap trees of which the pods are used as a substitute for soap with which to wash ladies' hair in China. Seeds formerly sent under Nos. 202a and 203a (S. P. I. Nos. 18432 and 18433)." (*Meyer.*)

21278. Papaver somniferum. **Opium poppy.**

From Shanghai, China. Received through Mr. Frank N. Meyer, agricultural explorer, August 24, 1907.

"(No. 739a, July 22, 1907.) The ordinary variety of opium poppy as grown in the southeastern part of Chehkiang province in China. Obtained from Dr. H. G. C. Hallock, S'hai." (*Meyer.*)

21280. Canarium commune.

From Buitenzorg, Java. Presented by Dr. M. Treub, August 21, 1907.

See S. P. I. No. 20808.

21283. Colocasia antiquorum. **Taro.**

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture, August 30, 1907.

"Malay name *Talus pandan.*" (*Treub.*)

21284. Citrus sp. (?).

From Tula, Vera Cruz, Mexico. Presented by Mr. Edward Everest, manager of the Commonwealth Plantation Company, through Mr. O. W. Barrett, August 30, 1907.

Sent in as "Limoncillo" by Mr. Everest.

21285 to 21297.

From Bombay, India. Received from Messrs. Latham & Co., through Prof. C. V. Piper. Received September 4, 1907.

A collection of legumes; the notes were received with the seeds.

21285. Dolichos biflorus. **Kulthi.**

Vernacular name, *Kollu-Karoopoo niram.* A black-seeded variety from Madras province.

21286. Dolichos biflorus. **Kulthi.**

Vernacular name, *Kollu-Samhal niram.* A gray-seeded variety from Madras province.

21287. Panicum colonum.

Vernacular name, *Swank.* From Pimjale province.

21288. Pisum arvense. **Field pea.**

Bangalia. Vernacular name, *Mattar.* From Agricultural Department, United Provinces, Cawnpore, India.

21289. Pisum arvense. **Field pea.**

Desi. Vernacular name, *Mattar.* From Agricultural Department, United Provinces, Cawnpore, India.

21290. Pisum arvense. **Field pea.**

Kabilya. Vernacular name, *Mattar.* From Agricultural Department, United Provinces, Cawnpore, India.

21291. Phaseolus calcaratus.

Lobiya. From Department of Land Records and Agriculture, Rangoon district, Burma, India.

21292. Vigna catjang. **Cowpea.**

Vernacular name, *Lal-rawani.* A reddish variety.

21293. Vigna catjang. **Cowpea.**

Vernacular name, *Rawan.* A white and brown mixture from Pimjale province.

21285 to 21297—Continued.

21294. VIGNA UNGUICULATA. **Cowpea.**

Vernacular name, *Carramunny-pyre.* From Madras province.

21295. VIGNA UNGUICULATA. **Cowpea.**

Vernacular names, *Harwanh chata, Naki rawani,* and *Gungi rawani.* From Pimjale province.

21296. VIGNA CATJANG. **Cowpea.**

Chowlee. From Department of Land Records and Agriculture, Rangoon district, Burma, India.

21297. VIGNA UNGUICULATA. **Cowpea.**

Vernacular names, *Lobia, Rawan,* and *Rawang.* From Pimjale province.

21298. MELOCANNA BAMBUSOIDES. (?) **Bamboo.**

From Darjeeling, Bengal, British India. Presented by Mr. W. A. Kennedy, curator, Lloyd Botanic Garden, through the Bengal Forest Department. Received September 5, 1907.

(See description under S. P. I. No. 21347 for comparison.)

21299 and 21300.

From Piracicaba, São Paulo, Brazil. Received from Dr. J. William Hart, director of the Agricultural College, through Prof. C. V. Piper, August 31, 1907.

21299. VIGNA UNGUICULATA. **Cowpea.**

Macassar or *Blue* cowpea. "Less vigorous at first, but ultimately outclasses other varieties in vigor and productiveness. Locally known as *Feijão macassar.*" (*Hart.*) (See also S. P. I. No. 21006.)

21300. MUCUNA GIGANTEA. **Velvet bean.**

"Ripens one month later than the ordinary velvet bean." (*Hart.*)

21302. DAUCUS CAROTA. **Carrot.**

From Soochow, China. Presented by Dr. W. H. Park, of the Soochow Hospital, through Mr. F. N. Meyer, agricultural explorer. Received August 29, 1907.

"Found on inquiry not to grow in this part of China, but in the northern part of this province in the deep, loose soil of the Yellow River. Original seed bought from a peddler and planted in the garden, and these seeds were collected from two plants grown from them. On account of its great length of over a foot or more it needs deep soil. *Yellow River* carrot or *Chinese Wonder* suggested as varietal names." (*Park.*)

"There are several varieties of carrot which might come under this description, but probably those sent are what are known as *Yellow Belgium* in this country. There is another called *Long Lemon-Colored.* I don't think any of them are very desirable, at least here where a darker colored sort is preferred." (*W. W. Tracy, sr.*)

21306 and 21307.

From Wellington Point, Brisbane, Queensland, Australia. Presented by Mr. James Pink. Received September 9, 1907.

21306. CITRUS AUSTRALASICA. **Finger lime.**

"This citrus is very local in its distribution and, so far as I know, is found only on the slopes of Tambourine Mountain, about 80 miles south from Brisbane." (*Pink.*) (See also S. P. I. Nos. 14993 and 18550.)

21307. RUBUS sp. **Raspberry.**

Federal.

21308 to 21310. GLADIOLUS sp. **Gladiolus.**

From Nylstroom (Waterberg), Transvaal. Received from Barlow, Chandler & Co., Eden Nurseries, September 10, 1907.

The following gladioli were procured for Mr. T. H. Kearney's cytological work: 21308 (B., C. & Co. No. 1); 21309 (B., C. & Co. No. 2); 21310 (B., C. & Co. No. 3.).

21311. ZEA MAYS. **Corn.**

From Bloemfontein, Orange River Colony. Presented by Mr. S. Galbraith, government agronomist, through Prof. C. V. Piper. Received September 11, 1907.

Apache. "The *Apache* corn from Central America promises to revolutionize our mealie (corn) production. This year I had only one-twentieth acre growing and the yields are very great, being 7,660 pounds (cobs and grain) per acre, a marvelous yield for this country, since the average yield is about 3 to 10 sacks (203 pounds) per morgen. Should the *Apache* mealie continue to yield as at present I will have some satisfaction after so much disappointment from drought and locusts. I might state that the weights quoted are those of the newly harvested cobs." (*Galbraith.*)

21312 to 21316.

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, agrostologist and botanist, Transvaal Department of Agriculture, through Prof. C. V. Piper. Received September 9, 1907.

21312. CHLORIS VIRGATA.

21313. ERAGROSTIS CURVULA.

21314. CHAETOCHLOA NIGRIROSTRIS.

21315. CHLORIS GAYANA.

21316. PASPALUM SCROBICULATUM.

21317. BAMBUSA ARUNDINACEA. **Bamboo.**

From Sibpur, Calcutta, India. Presented by Capt. A. T. Gage, superintendent, Royal Botanic Garden, through Mr. David Fairchild. Received September 13, 1907.

"This plant is found growing throughout India, Burma, and Ceylon, except in the Himalayan and sub-Himalayan tract and the valleys of the Ganges and the Indus; often cultivated and very ornamental.

"A magnificent species, at once recognized by its thorns and its peculiar culm sheaths. The culms are rather soft wooded though stout, and are bright green. They reach 80 to 100 feet in height and 6 to 7 inches in diameter, and have cavities in diameter nearly one-third of that of the culms. The forests are difficult to work because the culms interlace so much and are so much mixed up with thorny branchlets that they can not easily be extracted singly. They are used for building, mats, baskets, and all sorts of purposes. Flowering years occur at intervals of about thirty years in any given locality, and the seed is eagerly sought for as food. The leaves are sometimes attacked by an aphid, *Oregma bambusae*, which covers them with a black, sticky gum. Weight of wood, 45 to 50 pounds per cubic foot." (*Gamble, Manual of Indian Timbers.*)

"This bamboo certainly endures a temperature of 40° F. and it is believed that it would stand a few degrees of frost, as it grows well at Dehre Dun, where a slight frost is occasionally experienced." (*W. W. Smith, of the Royal Botanic Garden.*)

21318. GREIGIA SPHACELATA. **Chupon.**

From Coronel, Chile. Presented by Mr. Teodoro Finger. Received September 12, 1907.

"'Chupon de Chile.' Fruit edible and odorous; people are very fond of it. Prefers wet soil, not too poor, and not too cold or hot." (*Finger.*)

21318—Continued.

"Highly recommended as a decorative plant for the hothouse. It can not compare with other Bromeliads for its flowers, but is a handsome plant for its foliage. Leaves crowded into a head, at first erect then gracefully drooping, of leathery texture, barely an inch wide and 3 feet in length. Flowers borne on spikes in the axils of the lower leaves." (*Gartenflora, Vol. XIV, p. 137, 1865.*) (See also S. P. I. No. 3361.)

21319 and 21320.

From Ichang, China. Secured by Mr. E. H. Wilson, of the Arnold Arboretum, Jamaica Plain, Mass., in cooperation with this Department. Received September 18 and 19, 1907.

21319. RHEUM sp. **Rhubarb.**

"(No. 101.) The medicinal rhubarb of western Hupeh. It occurs wild in woods above 7,000 feet, but is now extremely rare. It is sparingly cultivated by the peasants in the mountains at altitudes between 6,000 and 8,000 feet. The seeds sent are from plants cultivated at 6,500 feet in the Hsing-shan district. The quality of this Hupeh rhubarb is poor and its market value low as compared with the Szechuan drug." (*Wilson.*)

21320. FRAGARIA DUCHESNE. **Strawberry.**

"(No. 102.) There are two strawberries in the mountains here above 4,000 feet altitude—one the common *Hantboncy* (*Fragaria elatior*); the other a red-fruited woodland variety of good flavor. The seeds sent are in all probability of the latter species, but since I did not gather them myself, I am not absolutely certain." (*Wilson.*)

21321. PANICUM SPECTABILE.

From Piracicaba, São Paulo, Brazil. Presented by Dr. J. W. Hart, director of the Agricultural College, through Prof. C. V. Piper. Received July 19, 1907.

21322 to 21327.

From Georgetown, British Guiana. Presented by Prof. A. W. Bartlett, government botanist, Botanic Gardens, through Prof. C. V. Piper. Received August 12, 1907.

21322. PACHIRA INSIGNIS.

21323. PACHIRA AQUATICA.

21324. SOPHORA TOMENTOSA.

21325. INDIGOFERA ANIL.

21326. CROTALARIA INCANA.

21327. CLITORIA ARBORESCENS.

21329 to 21346.

From Richmond, New South Wales, Australia. Presented by Mr. H. W. Potts, principal, Hawkesbury Agricultural College. Received July 13, 1907.

21329. ANDROPOGON AFFINIS.

21330. ANDROPOGON INTERMEDIUS.

21331. ANDROPOGON PERTUSUS.

21332. CHLORIS TRUNCATA.

21333. DANTHONIA PENICILLATA.

21334. ERAGROSTIS PILOSA.

21335. ERAGROSTIS PILOSA (?). (Perennial variety.)

21336. ERAGROSTIS LEPTOSTACHYA.

21337. ERAGROSTIS BROWNEI.

21338. MICROLAENA STIPOIDES.

21339. PANICUM DECOMPOSITUM.

21340. PANICUM EFFUSUM.

21341. PANICUM FLAVIDUM.

21342. PANICUM GRACILE.

21343. PANICUM TRACHYRHACHIS.

21344. PASPALUM BREVIFOLIUM.

21345. PASPALUM SCROBICULATUM.

21346. ANDROPOGON AUSTRALIS. From Inverill, New South Wales.

21347. MELOCANNA BAMBUSOIDES. **Muli bamboo.**

From Chittagong, British India. Presented by Deputy Conservator of Forests, Chittagong division, through Mr. W. F. L. Tottenham, Conservator of Forests, Bengal, India. Received September 20, 1907.

"The culms reach a height of 50 to 70 feet, with a circumference of 12 to 13 inches at the base.

"It has been stated that *M. bambusoides* dies immediately after fruiting, but Doctor Anderson, superintendent of the botanic gardens at Calcutta, states that in no case of which he was aware during the flowering period of 1857–58 did a general death of the bamboo follow. The foliage almost entirely disappeared during the flowering, and the flowering shoots died, but they were replaced by young shoots.

"The fruit is very curious in form and size as compared with other bamboos. The true seed inside the pericarp, about the size and shape of a betel nut (small pear), is very pleasant eating and not at all austere, though without much flavor. The natives declare the whole fruit is edible after baking." (*Theobald. From Colonel Munro's monograph of the Bambusaceae.*)

21349. BAMBUSA VULGARIS. **Bamboo.**

From Cannes, France. Received from M. Jh. Augier Gerant, Villa les Cocotiers. Received September 23, 1907.

"The Bamboo *thouarsii* sprouts only in winter—at the end of September. The cold freezes the new stems rather frequently. The old stems can resist a temperature of —6° C., while the new stems have been known to freeze at —3° C." (*Gerant.*)

21350 to 21356.

From Teyhampett, Madras, India. Presented by Mr. B. F. Cavanagh superintendent of the Agri-Horticultural Society, through Prof. C. V. Piper. Received July 13, 1907.

The following seeds, with Tamil names in italic:

21350. CAJANUS INDICUS. **Pigeon pea.**

Thovvaroe.

21351. CICER ARIETINUM. **Chick pea.**

Kadalai.

21352. DOLICHOS LABLAB. **Hyacinth bean.**

Mockakottae. White seeded.

21353. DOLICHOS BIFLORUS. **Kulthi.**

Karapa kollu. Black seeded.

21354. DOLICHOS BIFLORUS. **Kulthi.**

Kollu-sambal. Gray seeded.

21355. PHASEOLUS VULGARIS. **Bean.**

Nattu. The brown bean of the country.

21356. PHASEOLUS VULGARIS. **Bean.**

Vallay. White bean.

21357 to 21360. ALOCASIA CUCULLATA. **Taro.**

From Island of Guam. Presented by Mr. H. L. W. Costenoble, superintendent, Agricultural Experiment Station, U. S. Naval Station, through Mr. O. W. Barrett. Received September 26, 1907.

A collection of taros, or "sunes," by which latter name they are known in the island of Guam. The local varietal name by which they are grown in that island is given under each number. Plants received under synonym of *Caladium colocasia.*

21357. *Visaya apaka.*

21358. *Visaya* sp.

21359. *Mamla atilon.*

21360. *Panemia agaga.*

21361. PANICUM MOLLE. **Para grass.**

From Santos, Brazil. Presented by Mr. W. H. Lawrence, American vice-consul, through Prof. C. V. Piper. Received September 25, 1907.

21364 to 21367.

From Sydney, New South Wales. Received from Messrs. Anderson & Co., 399 George street, San Francisco, Cal., October 1, 1907.

21364. BROMUS UNIOLOIDES. **Rescue grass.**

South coast of New South Wales—dairying districts between Sydney and the Victorian border.

21365. DACTYLIS GLOMERATA. **Orchard grass.**

New Zealand, Canterbury district.

21366. PHLEUM PRATENSE. **Timothy.**

New Zealand grown.

21367. FESTUCA PRATENSIS. **Meadow fescue.**

European.

21368. SESBANIA ACULEATA.

From Sibpur, Calcutta, India. Presented by Prof. A. T. Gage, superintendent, Royal Botanic Garden. Received September 27, 1907.

"The *Danchi.* Intra-tropical and subtropical Asia, Africa, and Australia. This tall annual plant has proved adapted even for desert regions. Has grown very vigorously in the dry Wimmera region without application of water." (*St. Eloy D'Alton.*)

"Easily grown; the produce heavy. It yields a tough fiber for ropes, nets, and cordage, valued at from 30 pounds to 40 pounds per ton. Indian experiments showed the strength 50 per cent more than the government standard there requires. A rope of 3½ inches thickness broke only at 75 hundredweight. Stem and branches sought for the best gunpowder coal." (*De Rinzi.*)

"The foliage serves as fodder. Several congeneric plants can be equally well utilized." (*F. von Mueller.*)

Introduced to compare with *Sesbania macrocarpa* as a cover and green manure crop and for the purpose of breeding with it.

21371. CUCURBITA MAXIMA. **Squash.**

From Victoria, Mexico. Collected by Dr. Edward Palmer and presented to the Department October 1, 1907.

"'Calabaza de Castilla' (*Castile* squash.) In warm latitudes the plants hold over three or four years and are often pruned of old branches, when their productiveness is equal to that of a new plant. The young fruits, eaten as a vegetable and put into soups, are superior to summer squash. Old fruits are baked and, with a sirup of brown sugar, are used as a dessert for dinner. In its mature state the fruit is cut up into three-cornered pieces and candied, when it forms one of Mexico's finest sweets. The seeds when parched are shelled, and, with the addition of brown sugar, are made into candy, or, pulverized, are added to the stuffing of cooked chicken or turkey, and are much eaten in the manner of peanuts. The flowers (male) are put into soups or are often made into a very toothsome dish by themselves." (*Palmer.*)

21372 to 21393.

From Wagga-Wagga, New South Wales, Australia. Presented by Mr. G. Maurice McKeown, manager, Wagga Experimental Farm. Received October 4, 1907.

A collection of wheats, with some pedigreed oats and barleys.

21372 to 21376. TRITICUM VULGARE. **Wheat.**

21372. *Silver King.*

21373. *Hudson's Early Purple Straw.*

21374. *Farmers' Friend.*

21375. *Marshall's No. 3.*

21376. *White Essex.*

21372 to 21393—Continued.

21377 to 21383. Hordeum vulgare. **Barley.**

21377. *Standwell.*

- *Standwell.*[a]
  - *Fan.*
  - *Golden Melon.*

21378. *Maltster.*

- *Maltster.*[a]
  - ——
    - *Jewel.*
    - *Italian.*
  - ——
    - *Chevalier.*
    - *Invincible.*

21379. *Brewers' Favorite.*

- *Brewers' Favorite.*[a]
  - ——
    - *Standwell.*
      - *Fan.*
      - *Golden Melon.*
    - *Chevalier.*
  - *Chevalier.*

21380. *Kinver.*

21381. *Golden Grain.*

21382. *Hallett's Chevalier.*

21383. *Invincible.*

- *Invincible.*[a]
  - ——
    - *Chevalier.*
    - *Golden Melon.*
  - *Standwell.*

21384 to 21393. Avena sativa. **Oats.**

21384. *Danish Island.*

21385. *Silver Mine.*

21386. *Big Four.*

21387. *Storm King.*

- *Storm King.*[a]
  - ——
    - *White August.*
    - *White Swedish.*
  - *Scotch Potato.*
    - *White Tartarian.*
    - *Abundance.*

21388. *Tartar King.*

21389. *Great Northern.*

21390. *Ligowo White.*

21391. *Goldfinder.*

- *Goldfinder.*[a]
  - ——
    - *White Canadian.*
    - *Yellow Poland.*
  - *Winter.*

21392. *Abundance.*

- *Abundance.*[a]
  - *White August.*
  - *White Swedish.*

21393. *Colossal.*

- *Colossal.*[a]
  - ——
    - *White August.*
    - *White Swedish.*
  - ——
    - *Flanders' Yellow.*
    - *Waterloo.*

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[a] Genealogical chart showing pedigree.

21394. Eucalyptus alba.

From Buitenzorg, Java. Presented by Dr. M. Treub, director, Botanic Gardens. Received October 4, 1907.

"Timor and North Australia; also New Guinea. This species proved well adapted for the lowland clime of Ceylon, growing fast and seeding freely." (*Dr. Henry Trimeen.*)

For experiments on the Canal Zone.

21395 to 21471. Oryza sativa. **Rice.**

From Honolulu, Hawaii. Received through Mr. F. G. Krauss, in charge of Hawaii rice investigations, Hawaii Agricultural Experiment Station, October 1, 1907.

The rice seed bearing the following numbers was raised at the Hawaii Agricultural Experiment Station in 1906 from seed furnished by this office, and in each case the original S. P. I. number of the seed from which these samples were selected is given. According to Mr. Krauss the seed is considerably improved by selection over the original stock sent to Hawaii, which was of mixed strains and of weak germination.

21395. *Sunkhavel.*

Grown from S. P. I. No. 8689. Original seed from India.

21396. *Ambamore.*

Grown from S. P. I. No. 8690. Original seed from India.

21397. *Arong* paddy.

Grown from S. P. I. No. 12479. Original seed from Straits Settlements.

21398 to 21413.

Original samples from British Guiana. They are distinguished by numbers only.

21398. Grown from S. P. I. No. 12490.

21399. Grown from S. P. I. No. 12491.

21400. Grown from S. P. I. No. 12492.

21401. Grown from S. P. I. No. 12493.

21402. Grown from S. P. I. No. 12494.

21403. Grown from S. P. I. No. 12495.

21404. Grown from S. P. I. No. 12496.

21405. Grown from S. P. I. No. 12498.

21406. Grown from S. P. I. No. 12499.

21407. Grown from S. P. I. No. 12500.

21408. Grown from S. P. I. No. 12501.

21409. Grown from S. P. I. No. 12502.

21410. Grown from S. P. I. No. 12504.

21411. Grown from S. P. I. No. 12507.

21412. Grown from S. P. I. No. 12508.

21413. Grown from S. P. I. No. 12510.

21414 and 21415.

Original seed from Egypt.

21414. *Soultani* (or *Sultani*) paddy.

Grown from S. P. I. No. 12514 A.

21415. *Soultani* (or *Sultani*) paddy.

Grown from S. P. I. No. 12514 B.

21395 to 21471—Continued.

21416 to 21420.

Original seed from Java.

21416. *Magetan* paddy.

Grown from S. P. I. No. 12541 A.

21417. *Magetan* paddy.

Grown from S. P. I. No. 12541 B.

21418. *Pekalongan* paddy.

Grown from S. P. I. No. 12542.

21419. *Pekalongan* paddy.

Grown from S. P. I. No. 12543 A.

21420. *Pekalongan* paddy.

Grown from S. P. I. No. 12543 B.

21421.

Grown from S. P. I. No. 12766. Original seed from Korea.

21422 to 21428.

Original seed from India.

21422. *Masiua ghaiya.*

Grown from S. P. I. No. 12865.

21423. *Bhadai ghaiya.*

Grown from S. P. I. No. 12866.

21424. *Thosar Bhadai ghaiya.*

Grown from S. P. I. No. 12867.

21425. *Pakhasali Bhadai.*

Grown from S. P. I. No. 12868.

21426. *Augua Bhadai.*

Grown from S. P. I. No. 12869.

21427. Grown from S. P. I. No. 12870.

21428. *Takmaroo ghaiya.*

Grown from S. P. I. No. 12871.

21429 to 21431.

Original seed from China.

21429. *Shie-Miu.*

Grown from S. P. I. No. 12874.

21430. *Ai-Miu.*

Grown from S. P. I. No. 12875.

21431. *Laer-Chap.*

Grown from S. P. I. No. 12876.

21432 to 21442.

Original seed from Formosa.

21432. *Chieng Yu.*

Grown from S. P. I. No. 13035.

21433. *Pei Cham.*

Grown from S. P. I. No. 13036.

21395 to 21471—Continued.

21432 to 21442—Continued.

Original seed from Formosa—Continued.

21434. *Chieng Yu.*

Grown from S. P. I. No. 13037.

21435. *Kuai Kau Otowa.*

Grown from S. P. I. No. 13041.

21436. *O Cham Ko.*

Grown from S. P. I. No. 13044.

21437. *Pa Chiam.*

Grown from S. P. I. No. 13056.

21438. *O Kaku.*

Grown from S. P. I. No. 13057.

21439. *O Kaku.*

Grown from S. P. I. No. 13060.

21440. *Shun Tsui Ban.*

Grown from S. P. I. No. 13062.

21441. *Chino.*

Grown from S. P. I. No. 13064.

21442. *O Ka Hoe Rai.*

Grown from S. P. I. No. 13065.

21443 to 21447.

Original seed from India.

21443. *Badshah Bhog.*

Grown from S. P. I. No. 14779.

21444. *Kamod.*

Grown from S. P. I. No. 14781.

21445. *Basmati.*

Grown from S. P. I. No. 14782.

21446. *Dad Khani.*

Grown from S. P. I. No. 14783.

21447. *Ambe Mohr.*

Grown from S. P. I. No. 14784.

21448 to 21452.

Original seed from India.

21448. *Jeeragasamba.*

Grown from S. P. I. No. 16980.

21449. *Varikarudan.*

Grown from S. P. I. No. 16981.

21450. *Milagi.*

Grown from S. P. I. No. 16982.

21451. *Vellakattai*, or *Sirumanian.*

Grown from S. P. I. No. 16983.

21452. *Erangal*, or *Naryan.*

Grown from S. P. I. No. 16984.

21453.

Original seed from Texas. Grown from S. P. I. No. 17144.

21395 to 21471—Continued.

21454 to 21456.

Original seed from China.

21454. Grown from S. P. I. No. 17915.

21455. Grown from S. P. I. No. 17916.

21456. Grown from S. P. I. No. 17917.

21457 to 21468.

"Grown from stock seed received from Prof. Wm. S. Lyon, horticulturist in charge of Seed and Plant Introduction, Bureau of Agriculture, Manila, P. I." (*Krauss.*)

21457. *Binalayang.*

21458. *Benearuy.*

21459. *Kirikiri.*

21460. *Makalit.*

21461. *Continido.*

21462. *Diketalacay.*

21463. *Mantica.*

21464. *Cavitena.*

21465. *Mormoray.*

21466. *Enero.*

21467. *Ganado.*

21468. *Ay-yr-jip.* (Krauss's No. 152.)

21469 to 21471.

Hawaiian grown seed.

21469. Select Hawaiian rice. (Krauss's No. 150.)

21470. Hawaiian Gold Seed. (Krauss's No. 151.)

21471. Japan seed rice. (Krauss's No. 153.)

21472. COSTUS sp. (?) **Spiral flag.**

From Princestown, Trinidad, British West Indies. Received through Mr. O. W. Barrett, Port of Spain, Trinidad, October 7, 1907.

"This scitamine produces a white flower about 3 inches in diameter; the spikelike head of bracts is dull crimson. Habitat wet soil, perferably along streams." (*Barrett.*)

"More or less fleshy plants, prized in warm houses and grown in the open in southern Florida. They thrive in any rich, moist soil, but luxuriate in that of a gravelly or sandy character when under a partial shade. The plants are readily propagated by short cuttings of the stalk planted in sifted peat or fine moss and sand. Rather high temperature is required to bring out the rich colors of the leaves." (*Bailey.*)

21473. FURCRAEA sp.

From Nice, France. Presented by Dr. A. Robertson Proschowsky, through Mr. O. W. Barrett. Received October 4, 1907.

"A kind of Furcraea very hardy at Nice and having strong fibers in the leaves." (*Proschowsky.*)

21474. CAPSICUM FRUTESCENS. **Bird-pepper.**

From South America. Presented by Mr. Alva A. Adee, Second Assistant Secretary, Department of State, Washington, D. C. Received October 7, 1907.

"*Chile piquin* in Mexico, where it is native." (*C. F. Wheeler.*)

21474—Continued.

"They were given to me some two years ago by a multimillionaire fellow-voyager on the *Deutschland*, who used to crumble two or three of them into his soup as an agreeable condiment. He said they were sent to him from some South American country—Bolivia, I think. I enjoyed their pleasant flavor." (*Adee.*)

21475. BRASSICA sp. Cabbage.

From northern Manchuria. Presented by the Yokohama Nursery Company (Limited), Yokohama, Japan. Received October 10, 1907.

Kaijo white cabbage.

21476 and 21477. CYPERUS spp.

From near Honolulu, Oahu, Hawaii. Collected by Mr. F. G. Krauss, in charge of Hawaii rice investigations, Hawaii Agricultural Experiment Station, in 1907, at the request of Mr. David Fairchild. Received October 1, 1907.

21476. CYPERUS LAEVIGATUS.

"*Ehuawa.* In and near sweet or brackish water, plentiful near Honolulu. A common plant in many tropical countries of the New and the Old World, extending also to the Cape of Good Hope and the Mediterranean region. The fine and highly prized Niihau mats are made of this plant." (*Hillebrand.*)

21477. CYPERUS PENNATUS.

"*Molokai.* The plant grows quite abundantly along the shores of brackish marshes in the neighborhood of Honolulu and elsewhere in Hawaii." (*Krauss.*)

"In the lower regions; sometimes gregarious. The species extends from the Mascarene Islands and India through Malaysia, Australia, and south China to the Philippines and most of the Pacific Islands." (*Hillebrand.*)

21478. PANICUM MOLLE. Para grass.

From São Paulo, Brazil. Presented by Dr. H. M. Lane, president, Mackenzie College, through Mr. C. V. Piper. Received June 12, 1907.

"This very coarse grass is from Africa and is known here as 'Capim de Angola.' It is the *Panicum scabrum* of Lam. and the *Oplismenus spectabilis* of Kunth. Its chief value is to cut for green forage. It is almost impossible to cure it, and it is of little value for pasture." (*Lane.*)

21481 and 21482.

From New York, N. Y. Received through Messrs. Parke, Davis & Co. Received October 15 and 16, 1907.

21481. PHYSOSTIGMA VENENOSUM. Calabar bean.

"A perennial climber, resembling the common scarlet runner, growing along the Gulf of Guinea, used there by pagan tribes in ordeal trial in witchcraft. It acts as a powerful depressant, poisonous in overdoses. The seeds from the article known on the crude drug market as Calabar bean." (*R. H. True.*)

21482. STRYCHNOS IGNATII. St. Ignatius bean.

"A large climbing shrub of the Visayan group of the Philippines. The large fruit contains several pebble-like seeds, going on the crude drug market as St. Ignatius beans. They contain the alkaloids strychnine and brucine, for the manufacture of which they are used to some extent." (*R. H. True.*)

21483 to 21485. Juglans regia. **Persian walnut.**

From Breslau, Germany. Presented by Mr. Julius Monhaupt's Successor. Received October 16, 1907.

21483. *Paper.*

"A small-sized nut, with shell of medium thickness and nearly smooth." (*Fischer.*)

21484. *Giant.*

"A very large sized nut with thick, rough shell." (*Fischer.*)

21485.

"Nut not quite so large as S. P. I. No. 21484; shell thick and less rough." (*Fischer.*)

21488 to 21499.

From M'lanje, British Central Africa. Presented by Mr. Henry Brown, Thornwood estate, through Mr. O. W. Barrett. Received August 19, 1907.

21488. Andropogon sp.
21489. Eragrostis sp.
21490. Eragrostis sp.
21491. Eragrostis sp.
21492. Panicum (?).
21493. Pennisetum sp.
21494. Pennisetum sp.
21495. Chaetochloa aurea.
21496. Sporobolus sp.
21497. Anthistiria imberbis.
21498. Trichopteryx elegans.
21499. Xyris sp.

21504. Lygeum spartum.

From Paris, France. Received from Messrs. Vilmorin-Andrieux & Co., October 14, 1907.

"Has a creeping rhizome and stiff, rush-like, convolute leaves; in rocky soil on the high plains of the countries bordering the Mediterranean, especially of Spain and Algeria. A part of the Esparto (see *Stipa tenacissima*) is furnished by this plant." (*Hackel's translation from "Die Nat. Pflanzenf."*)

"Will probably be adapted to California and the Southwestern States." (*C. V. Piper.*)

(See S. P. I. No. 3334.)

21505. Citrus decumana. **Pomelo.**

From "La Vega" estate, Brasso, Trinidad, British West Indies. Presented by Mr. Robert de Verteuil through Mr. O. W. Barrett. Received October 22, 1907.

"A pomelo with pinkish colored pericarp." (*Barrett.*)

21507. Pimenta officinalis. **Allspice.**

From Kingston, Jamaica. Presented by Mr. William Fawcett, director, Hope Botanic Gardens. Received October 18, 1907.

Procured for experimental purposes at the request of Mr. J. G. Smith, of the Hawaii Agricultural Experiment Station.

21508 to 21511. Vigna spp. **Cowpea.**

From Arlington Farm, Rosslyn, Va. Grown during the season of 1907. Received October 31, 1907.

21508.

"Grown from seed received from the Tokyo Botanical Gardens, May, 1907. An erect, bushy, small-seeded cowpea, representing a species (?) not received from any other source. The seeds of this variety are black. Grown under the temporary No. .0512." (*C. V. Piper.*)

21508 to 21511—Continued.

21509.

"From the same source as S. P. I. No. 21508 and of similar habit. Seeds dark clay color. Grown under the temporary No. .0514." (*C. V. Piper.*)

21510.

"From the same source as S. P. I. No. 21509 and very similar in habit. Seeds small white, with large black eye. Grown under the temporary No. .0515." (*C. V. Piper.*)

21511.

"Grown from seed received from Dr. S. P. Barchett, Shanghai, China, June, 1907. A black-seeded variety related to the above (S. P. I. No. 21510). Grown under the temporary No. .0521." (*C. V. Piper.*)

21513. SECALE CEREALE. **Rye.**

From estate "Petkus," Baruth, Brandenburg, Germany. Received from Herr F. von Lochow, October 29, 1907.

Petkuser. "A pedigreed rye, produced by selection carried on for the last twenty-six years under the direction of Herr von Lochow, Petkus estate, Brandenburg, Germany, combining the best averages in the following quantities: Wintering, size and stiffness of straw, erectness of head, shape, color and plumpness of kernel, stooling, earliness of ripening, productiveness." (*Illus. Landwirtschaftliche Zeitung, April 7, 1906.*)

21514. AVENA SATIVA. **Oat.**

From Orebro, Sweden. Presented by Mr. C. A. Hagendahl's son, through Hon. Edward L. Adams, American consul-general, Stockholm, Sweden, at the request of Mr. A. J. Pieters. Received October 29, 1907.

Red Rustproof.

21515 to 21518. MANGIFERA INDICA. **Mango.**

From Port of Spain, Trinidad. Procured by Mr. O. W. Barrett. Received October 31, 1907.

21515. *Julie.*

21516. *Divine.*

21517. *Martin.*

21518. (Label indistinct.)

21520. BERBERIS THUNBERGII × VULGARIS PURPUREA. **Barberry.**

From Ottawa, Ontario, Canada. Presented by Mr. William Saunders, director of experimental farms, Central Experimental Farm. Received November 2, 1907.

21521. DIANTHUS CARYOPHYLLUS × BARBATUS. **Carnation.**

From Miami, Fla. Procured by Mr. P. J. Wester, Subtropical Laboratory and Garden. Received November 4, 1907.

"This variety, which I found growing in a back yard a few miles out of Miami, was blooming very profusely in July, and on that account its vigor attracted my attention. A few cuttings were secured, from which several propagations have been made. The plant is exceedingly vigorous and blooms well throughout the year and does not seem to be subject to any diseases so far. The flowers are dark red. It has been distributed during the past year and a half to several people in Florida under the name *Augusta*, Lab. No. 272. All who have received it are pleased with it." (*Wester.*)

21522 to 21529. MANIHOT spp. **Cassava.**

From Port of Spain, Trinidad. Presented by Mr. E. André. Received October 31, 1907.

21522 to 21525. MANIHOT PALMATA. **Sweet cassava.**

21522. *Butter Sticks.*

21523. *Boujon Bleu.*

21524. *Cammanioc Blanc.*

21525. *Cammanioc Rouge.*

21522 to 21529—Continued.

21526 to 21528. Manihot utilissima. **Bitter cassava.**

21526. *Vioux Bwai.* **21528.** *Mataoutel.*

21527. *Manioc Six Mois.*

21529. Manihot sp. **Cassava.**

"Bitter kinds are always designated as *Manioc;* sweet as *Cammanioc,* Of the sweet kinds sent *Butter Sticks* is considered a very good table variety.

"Neither in Venezuela nor here are the sweet kinds grown for starch, cassava bread, or farina; they are used only as a vegetable, being boiled and buttered. Those who make a business of cassava products say that it does not pay to grow the sweet kinds." (*André.*)

21532 to 21540.

From Nagpur, Central Provinces, India. Presented by Mr. F. Fletcher, deputy director of agriculture, Bombay. Received October 28 and November 5, 1907.

21532. Panicum psilopodium. **Millet.**

Kutki Raipur.

21533. Panicum psilopodium. **Millet.**

Kutki.

21534. Pisum arvense. **Field pea.**

Mattar.

21535. Vigna catjang. **Catjang.**

Burbudi.

21536. Vigna catjang. **Catjang.**

Burbadi.

21537. Vigna unguiculata. **Cowpea.**

Jhunga.

21538. Vigna catjang (?). **Catjang.**

Jhunga.

21539. Vigna catjang (?). **Catjang.**

Khed Jhunga.

21540. Panicum frumentaceum. **Millet.**

Sawan or *Sanwa.*

21542. Sesbania aegyptiaca.

From Saharanpur, India. Presented by Mr. J. H. Maiden, director, Botanic Gardens, Sydney, New South Wales, through Mr. David Fairchild. Received November 7, 1907.

"Africa, southern Asia, northern and central Australia, ranging to 33° north in Afghanistan and 33° south on the Darling River, ascending to 4,000 feet in the Himalayas. By Australian pasturalists called 'pea bush.' The foliage of this tall perennial herb and of the allied annual *S. brachycarpa* serves as fodder, which cattle are ravenously fond of. According to Mr. T. Gulliver, the green pods, as well as the seeds, are nutritious, wholesome, and of pleasant taste." (*F. von Mueller.*)

21543 to 21545.

From São Paulo, Brazil. Presented by Mr. T. Julius Schalch. Received November 5, 1907.

21543. MANIHOT UTILISSIMA. **Bitter cassava.**

"Manioc, a Brazilian plant growing in the Temperate Zone; produces roots 2 to 3 feet long, 3 to 4 inches in diameter; used exactly as Irish potatoes; can be boiled, baked, or fried, and is of very fine flavor. All the starch made down in that country is made of Manioc. Tapioca is also made from Manioc. It is planted on the same kind of soil as potatoes. Cut every stick in two or three pieces, 6 or 8 inches long, plant slanting on the hill about 3 or 4 feet apart. It will grow 7 to 10 feet high." (*Schalch.*)

21544. HAEMANTHUS MULTIFLORUS. **Imperial crown.**

"A beautiful, delicate flower growing in the Temperate Zone. To be planted the same as any bulb. Grows very easily if the temperature is right." (*Schalch.*)

21545. PISUM sp. **Pea.**

"Crooked pea is the name given in São Paulo for this kind of pea. It is a very tender, stringless variety, and can be cooked with the pods, for it is very sweet and extremely tender and makes a very palatable dish. It is planted the same as any pea and has always been raised in the Temperate Zone." (*Schalch.*)

21547. PYRUS POLLVERIA.

From Christiania, Norway. Presented by Prof. N. Wille. Received November 8, 1907.

In Gartenflora, of January 15, 1905, there is an article entitled "An Account of a Supposed Graft-Hybrid Between the Pear and the Hawthorn," in which the author, von Jens Holmboe, gives a good description of this tree and attempts to clear up the mystery of its probable origin.

The tree is located in the Manor of Torp, Parish Borge, in Smaalenene, between the towns of Fredrikstad and Sarpsborg, and was planted some time in the early seventies and discovered by an apothecary late in the eighties. It was grafted on *C. oxyacantha* but has characters intermediate between those of Pyrus and Crataegus. The fruit is small and pear shaped, but red like that of Crataegus. The taste is insipid and also intermediate between that of the pear and the hawthorn.

To the author it seemed that this curious hybrid resembled in most of its characters *Pyrus pollveria* L. (*P. communis* L.×*Sorbus aria* Crantz), and he states that it would be hard to separate it specifically from that species (or hybrid) on morphological characters only.

Since the foliage of some of the seedlings grown from the "Torp" tree could hardly be distinguished from that of the pear, and that of others resembled so closely that of *C. monogyna*, this form might again be considered a hybrid between *P. communis* and some species of Crataegus and the appearance of two distinct types in its progeny be perfectly natural. But here, too, it is mentioned that Crataegus-like foliage is in rare cases found among seedlings of both *P. communis* and *P. malus* and also that no Crataegus grew in the neighborhood which might have taken part in the cross-pollination of the flowers which gave rise to these seedlings.

Hence, according to the author, there are but two alternatives: The tree whose hybrid character admits of no doubt is either the rare *Pyrus pollvera*, which is not found anywhere outside of the Christiania Botanic Gardens, but found its way in some inexplicable manner, through a nursery located in Sarpsborg, into this garden; that the Crataegus-like foliage of the second hybrid generation, which in Norway has never before been observed in *P. communis* and its relatives, is due to a mutation; or that some until now entirely unknown hybrid of *P. communis*×*Crataegus* sp. existed in this same nursery and was unintentionally grafted upon the *Crataegus oxyacantha* stock.

In concluding, the author contends that it would require an extraordinary combination of circumstances to bring either of these alternatives about and

21547—Continued.

that after weighing all the evidence, both for and against them, he, personally, is of the opinion that the tree in question is probably a graft-hybrid, this being the easiest way to explain its origin, since so many years have passed since the graft was made. (*Abstracted and translated from the German by W. Fischer.*)

"The tree (in the Botanic Gardens in Christiania) from which these fruits were obtained stands in the vicinity of several varieties. Cross-fertilization is thus not excluded." (*Wille.*)

21548. DENDROCALAMUS STRICTUS. **Bamboo.**

From Sibpur, Calcutta, India. Presented by Mr. A. T. Gage, superintendent, Royal Botanic Garden, through Mr. David Fairchild. Received November 11, 1907.

"A very useful and strong bamboo of India, formerly used universally for spear staffs. The plant flowers frequently and does not die down after flowering, as is the case with so many bamboos. The culms are said sometimes to reach a height of 100 feet in the valleys and 40 feet on the hills." (*From Colonel Munro's Monograph of the Bambusaceae.*)

"This bamboo is common in parts of the province of Punjab, India, where the climate is very dry in summer and quite cool in winter, the temperature occasionally falling below freezing." (*Fairchild.*)

21551. CITRUS NOBILIS. **Mandarin.**

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, botanist, Transvaal Department of Agriculture. Received November 18, 1907.

"*Naartje.* This is a kind of mandarin which to my mind has a much better flavor than the ordinary tangerine of the Mediterranean; the fruit is larger and the skin can be removed quite as easily. I am under the impression that it comes fairly true to seed, but even if this should prove not to be the case, you may find the stocks of some use and the drought and frost resistance of the plant may render it useful for hybridizing or grafting purposes." (*Davy.*)

"The naartje has been produced in Cape Colony for the last two hundred years or more. It is difficult to say whence it came originally, but more than likely from the Dutch East Indies. I do not know of any orange under cultivation either in Florida or California which is the exact counterpart to the fruit which we grow here.

"We have introduced most of the varieties grown in America, and up to the present time none of them, with the exception of Satsuma, have shown the same hardiness and drought-resisting qualities as the original varieties in Cape Colony.

"With regard to their resistant powers against frost, I have seen old trees which have stood 15 degrees of frost with very little injury either to the tree or to the crop, and I consider for our purposes that they are the best fruits of the kind which we can grow in this colony. The trees as seedlings attain large sizes—from 16 to 18, and sometimes 20, feet—and they bear a striking resemblance to an ordinary seedling orange in growth. The two varieties are named locally the *Platskill* and *Groenskil.* The meaning of the first word is 'flat or smooth skin,' and it appears also to apply to the shape of the fruit. The skin of this variety adheres closely to the segments, and there is never any of the puffiness which accompanies so many varieties of mandarins; although so closely adhering, it can be easily removed with the thumb and finger, but it is not exactly what one would call a 'kid-glove' orange.

"The word *Groenskil* means green skin, and the fruit of this variety bears more resemblance to the Emperor mandarin perhaps than to most others. It hangs for a long time on the trees in good condition and is the latest ripening variety we have. It is also more hardy than the *Platskill.*" (*R. A. David, Transvaal Department of Agriculture.*)

21552 to 21557. DAHLIA spp. **Dahlia.**

From Mexico City, Mexico. Collected by Prof. C. G. Pringle on Sierra de Ajusco, a mountain on the south side of the Valley of Mexico, at an altitude of 8,500 feet, by request of Mr. David Fairchild. Received November 16 and 19, 1907.

Seeds and plants secured for hybridizing purposes.

21552 to 21557—Continued.

21552 and 21553. DAHLIA COCCINEA. **Dahlia.**

"This species varies in color from lemon yellow to brick red." (*Pringle.*)

21554 and 21555. DAHLIA MERCKII. **Dahlia.**

"This species varies in color from white to purplish." (*Pringle.*)

21556 and 21557. DAHLIA VARIABILIS. **Dahlia.**

"This species varies in color from deep purple to yellow with light purple tips." (*Pringle.*)

"The last three species were found growing in profusion on a lava field." (*Pringle.*)

"It appears as if *Dahlia coccinea* and *Dahlia merckii* have never been improved by crossing or even crossed on other species." (*G. W. Oliver.*)

21558 to 21565. VIGNA spp.

From Buitenzorg, Java. Presented by Dr. M. Treub, director, Botanic Gardens. Received November, 1907.

The Malay names and descriptions accompanied the seeds.

21558. VIGNA SESQUIPEDALUS.

Katjang pandjang. Striped seeds.

21559. VIGNA SESQUIPEDALUS.

Katjang Dadap. Uniform seeds.

21560. VIGNA SESQUIPEDALUS.

Katjang Belaet. Striped seeds, brown colored.

21561. VIGNA SESQUIPEDALUS.

Katjang Dadap. Uniform brown seeds.

21562. VIGNA SESQUIPEDALUS (?).

Katjang Dadap. Brown speckled seeds.

21563. VIGNA CATJANG.

Katjang Roedji. Brown seeds.

21564. VIGNA CATJANG.

Katjang Roedji. Uniform light green color.

21565. VIGNA CATJANG.

Katjang Landes.

21566 and 21567. MUCUNA spp.

From Kingston, Jamaica. Presented by Dr. William Fawcett, director, Hope Botanic Gardens. Received Nov. 18, 1907.

21566. MUCUNA PRURIENS. **Cow-itch bean.**

21567. MUCUNA URENS. **Horse-eye bean.**

21568 and 21569. VIGNA SESQUIPEDALUS (?).

From Buitenzorg, Java. Presented by Dr. M. Treub, director, Botanic Gardens. Received Nov. 21, 1907. (See Nos. 21558 to 21565.)

21568. *Katjang Belaet.* Brown speckled seeds.

21569. *Katjang Dadap.* Light speckled seeds.

21570 and 21571. RUBUS spp. **Raspberry.**

From Shanghai, China. Presented by Rev. J. M. W. Farnham, D. D., Chinese Tract Society. Received Oct. 23, 1907.

21570.

"Native wild black raspberry from Mokunshan, China." (*Farnham.*)

21571.

"Seeds of a wild raspberry." (*Farnham.*)

21572. JACQUEMONTIA PENTANTHA.

From Miami, Fla. Collected by Mr. P. J. Wester, special agent, Subtropical Laboratory and Garden. Received Nov. 23, 1907.

"Lab. No. 500. This plant is a perennial vine, moderately vigorous, and is native to the Florida Keys. The leaves are dark green, the flowers bright blue, about 2 centimeters in diameter, and one of the most dainty flowers I have ever seen. One to four flowers at a time open on the cyme, which contains several dozen flower buds. The plant is exceedingly floriferous, and I am sure that, being so distinct from all other flowers on climbing plants, it will prove an interesting acquisition to ornamental climbers." (*Wester.*)

21573. ANONA sp.

From Toco, Trinidad, British West Indies. Received through Mr. O. W. Barrett, Port of Spain, Trinidad, Nov. 25, 1907.

"Seeds of an Anona nearly related to *Anona squamosa;* fair fruit." (*Barrett.*)

21574 to 21582.

From Alexandretta, Turkey. A collection of seeds of leguminous plants made by Mrs. F. A. Shepard, American Medical Mission, Aintab, Turkey, at the request of Mr. David Fairchild. Received Oct. 18, 1907.

"The following are seeds of plants that grow on our arid hills and that the animals eat with avidity." (*Shepard.*)

21574. MEDICAGO TRIBULOIDES.

21575. MEDICAGO LUPULINA.

21576. MEDICAGO TUBERCULATA (?).

21577. TRIGONELLA RADIATA.

21578. TRIGONELLA CRASSIPES.

21579. TRIGONELLA MONANTHA.

"The following seeds I found at a village near the Amanus Mountains. These are used as fodder by the villagers in that region. They are dried for the animals for winter, and the peas are ground up and fed to cattle." (*Shepard.*)

21580. VICIA sp.

Yonja.

21581. VICIA sp.

Kushne.

21582. VICIA sp.

Pakla.

21583. CITRUS LIMONUM. **Lemon.**

From Riverside, Cal. Presented by Mr. James Mills, superintendent, Arlington Heights Fruit Company. Received November 25, 1907.

Villa Franca. The above cuttings were procured for Mr. D. W. May, Porto Rico Agricultural Experiment Station, Mayaguez, Porto Rico.

21584 to 21593.

From Bodoe, Tromsoë, Norway. Received from Mr. L. P. Nilssen, director of the agricultural school and experiment station, through Prof. N. E. Hansen, of the Agricultural Experiment Station, Brookings, S. Dak., as agricultural explorer for the Department of Agriculture, November 23, 1907.

21534 to 21593—Continued.

21584 to 21591. SOLANUM TUBEROSUM. **Potato.**

Grown at the agricultural school farm, Bodoe.

21584. *Flekket.*

"(No. 282.) From Loedingen, 68° 30′ N. lat., where it has been raised for a series of years." (*Hansen.*)

21585. *Flairball.*

"(No. 283.) Grown for a succession of years at the agricultural school at Bodoe, 67° 20′ N. lat." (*Hansen.*)

21586. *Russe.*

"(No. 284.) Cultivated for ten years at the agricultural school at Bodoe after having been raised for many years in Loedingen. Originally the stock came from Archangel, on the Arctic Ocean coast of European Russia." (*Hansen.*)

21587. *Swensk.*

"(No. 285.) Grown for six years on the agricultural school farm at Bodoe, after having been cultivated for many years at Tana, 70° 25′, Swedish Lapland." (*Hansen.*)

21588. *Tana*, white.

"(No. 286.) Cultivated for six years at the agricultural school at Bodoe, after being cultivated many years in Tana, Swedish Lapland." (*Hansen.*)

21589. *Loeding.*

"(No. 287.) Grown for a succession of years in Loedingen, northern Norway." (*Hansen.*)

21590. *Hoeyer.*

"(No. 288.) Grown for a succession of years in Loedingen, northern Norway." (*Hansen.*)

21591. *Svensk*, potato seeds.

"(No. 289.) Raised in 1907 at the agricultural school, Bodoe. The parent is described under S. P. I. No. 21587." (*Hansen.*)

21592 and 21593. HORDEUM VULGARE. **Barley.**

21592. *Finne.*

"(No. 290.) From Skjaerstad, 67° 15′, northern Norway." (*Hansen.*)

21593.

"(No. 291.) Barley of 1907 from Haarvik, in Loedingen, 68° 30′, northern Norway." (*Hansen.*)

21594 to 21598. CITRUS spp.

From Glen St. Mary, Fla. Propagated by Mr. G. L. Taber for distribution by the Office of Seed and Plant Introduction. Numbered November 26, 1907.

Hybrid citrus fruits developed by Dr. H. J. Webber, in charge of the Department Plant Breeding Laboratory.

21594. CITRUS TRIFOLIATA × AURANTIUM. **Citrange.**

Savage. (P. B. No. 779.) Budded on *trifoliata* stock.

21595. CITRUS NOBILIS × AURANTIUM.

Thornton. (P. B. No. 5.) Budded on sour stock.

21594 to 21598—Continued.

21596. CITRUS NOBILIS × DECUMANA. **Tangelo.**

Sampson. (P. B. No. 1316.) Budded on rough lemon stock.

21597. CITRUS NOBILIS × AURANTIUM. **Tangerine orange.**

Trimble. (P. B. No. 627.) Budded on rough lemon stock.

21598. CITRUS NOBILIS × AURANTIUM. **Tangerine orange.**

Weshart. (P. B. No. 628.) Budded on rough lemon stock.

21599. VIGNA UNGUICULATA. **Cowpea.**

From Olar, S. C. Received from Mr. A. W. Brabham, through Prof. C. V. Piper, November 26, 1907.

"*Brabham.* A variety originated by A. W. Brabham, Olar, S. C., which appeared as a natural hybrid in a field planted to alternate plants of Iron and Whippoorwill. The spotted seeds are quite intermediate between the Iron and the Whippoorwill. The plant has the erect habit of the Whippoorwill, holds its leaves satisfactorily as the Iron, and is remarkably prolific." (*Piper.*)

21600 to 21605.

From Poona, Bombay, India. Presented by Mr. F. Fletcher, Deputy Director of Agriculture. Received November 26, 1907.

21600. PHASEOLUS ACONITIFOLIUS. **Moth bean.**

Math. From agricultural station, Dhulia.

21601. PANICUM FRUMENTACEUM. **Millet.**

Banti. From agricultural station, Nadiad.

21602. VIGNA CATJANG. **Catjang.**

Chavali. From agricultural station, Nadiad.

21603. VIGNA CATJANG. **Catjang.**

Chola. From Katargam district, Surat.

21604. PANICUM FRUMENTACEUM. **Millet.**

Banti. From agricultural station, Surat.

21605. PISUM ARVENSE. **Field pea.**

Watana. From Walod district, Surat.

21606. ANONA CHERIMOLIA. **Cherimoyer.**

From Portici, Italy. Presented by Prof. L. Savastano, Royal School of Agriculture, through Mr. David Fairchild. Received November 29, 1907.

"*Anona cherimolia* is propagated exclusively by seed in Calabria. Varieties of it are not distinguished, which means that there are no varieties." (*Savastano.*)

21608. THESPESIA POPULNEA.

From Miami, Fla. Collected by Mr. P. J. Wester, special agent, Subtropical Laboratory and Garden. Received November 29, 1907.

"A tree native to the Florida Keys. It is quite attractive on account of its abundance of foliage, and, the leaves being somewhat thick and leathery, it might be well adapted for an avenue tree in cities. The flowers very closely resemble those of the cotton plant. The tree is apparently a very rapid grower and seems to transplant easily." (*Wester.*)

The same as No. 11768, inventory No. 11.

21609. CANAVALIA ENSIFORMIS. **Knife bean.**

From Piracicaba, Brazil. Presented by Dr. J. William Hart, director, Agricultural College, through Prof. C. V. Piper. Received November 30, 1907.

A bush form.

21610. SESBANIA AEGYPTIACA.

From India. Presented by Mr. W. R. Guilfoyle, director, Botanic Gardens, Melbourne, Australia. Received December 2, 1907.

(See S. P. I. No. 21542 for description.)

21611. PLOCAMA PENDULA.

From Monte, Grand Canary, Canary Islands. Presented by Mr. Alaricus Delmard. Received December 2, 1907.

"Seeds of a species of low-growing shrub which grows on the slopes of the arid hillsides in the Canary Islands. It has a most beautiful weeping habit, giving the plants the appearance of tiny weeping willows, not over 2½ to 3 feet high. This would be very beautiful as a cover for dry hillsides overlooking the sea. It has already been brought into culture. Will probably withstand severe drought." (*Fairchild.*)

21612. JUGLANS NIGRA × REGIA. **Walnut.**

From Pasadena, Cal. Presented by Mr. J. B. Wagner. Received December 4, 1907.

"Wagner's *Giant Hybrid.* This is a cross between Eastern Black and Santa Barbara Soft Shell. It is now about 20 inches in diameter—6 years from seed—while neither of its parents at same age, grown within 50 feet of it under same conditions, is over 5 inches in diameter. This, I believe, and Burbank says, is the most rapid growing hardwood tree in existence and a boon as wood and lumber." (*Wagner.*) (See also Nos. 19261 and 21710.)

21613. MUCUNA FAWCETTII.

From Kingston, Jamaica. Presented by Dr. William Fawcett, director, Hope Botanic Gardens. Received December 5, 1907.

21616 to 21639.

From Peking, Chi-li, China. Received through Mr. Frank N. Meyer, agricultural explorer, December 6 and 9, 1907.

21616. DIOSCOREA sp. **Yam.**

From Peking, Chi-li, China. "(No. 741a, Oct. 22, 1907.) A yam grown extensively in northern China, the roots being boiled and eaten; sometimes sugar coated and sold as a sweetmeat. A trifle sharp of taste. Can grow in rather alkaline soil, but loves drainage and deep soil; sometimes the tubers grow to be 4 feet long." (*Meyer.*)

21617. CHIONANTHUS RETUSA (?). **Chinese fringe tree.**

From Boshan, Shantung, China. "(No. 740a, Sept. 19, 1907.) An oleaceous, deciduous tree with Rhamnus-like leaves and bearing in spring a multitude of white, fringed, fragrant flowers, followed in the fall by masses of blue berries, looking like wild grapes. This tree is used by the Chinese to graft their *Olea fragrans* upon. Chinese name *Pai lou pi.*" (*Meyer.*)

21618. ZIZYPHUS SATIVA. **Jujube.**

From Laoling, Shantung, China. "(No. 743a, Sept. 30, 1907.) This variety, called *Chin sze tsao*, is said to be the best variety for the so-called honey jujube manufacture. It is a remarkably sweet variety." (*Meyer.*)

21616 to 21639—Continued.

21619. ZIZYPHUS SATIVA. **Jujube.**

From Hwei-goir, Shantung, China. "(No. 744a, Sept. 27, 1907.) This variety is called *Yuen ling tsao* or *Su hsin tsao*. The fruits are being steamed and smoked and sold as smoked dates, *Ghee tsao*." (*Meyer.*)

21620. ROSA XANTHINA. **Rose.**

From Shushan, Shantung, China. "(No. 745a, Aug. 23, 1907.) This beautiful single yellow rose, *Rosa xanthina*, growing in dry, rocky localities and mostly in sheltered places, produces masses of delicate yellow flowers in early summer. Is used by the Chinese as a grafting stock for the tea varieties of roses." (*Meyer.*)

21621. BRASSICA CHINENSIS. **Chinese turnip.**

From Wei-hsien, Shantung, China. "(No. 746a, Aug. 20, 1907.) A round, white turnip; Chinese name *Yuen man ching*. Said to be a superior variety of turnip, growing well in irrigated soil and attaining its best growth when the cool weather starts." (*Meyer.*)

21622. BRASSICA CHINENSIS. **Chinese turnip.**

From Wei-hsien, Shantung, China. "(No. 747a, Aug. 20, 1907.) A long, white turnip; Chinese name *Chang man ching*. To this variety the same remarks apply as to the preceding number, 746a (S. P. I. No. 21621.)" (*Meyer.*)

21623. RAPHANUS SATIVUS. **Radish.**

From Wei-hsien, Shantung, China. "(No. 748a, Aug. 20, 1907.) Green turnip-radish. Chinese name *Chang lo bo*. A peculiar variety of this group; has excellent stomachic properties, being appetizing and promoting digestion; is always eaten raw, either sliced or shredded. It loves a deep, well-drained soil and must not lack water when becoming mature; otherwise it has a tendency to become pungent." (*Meyer.*)

21624. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Wei-hsien, Shantung, China. "(No. 749a, Aug. 20, 1907.) A large variety of white cabbage; Chinese name *Ta pai tsay*. It requires a rich, well-drained soil and an abundance of water during the whole period of growth; sown in seed beds in the latter half of June or in early July, and planted in its permanent place in the last week of August or in the early days of September at distances varying from 1½ to 2½ feet, according to richness of soil and hardiness of variety." (*Meyer.*)

21625. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Yen-tchou-fu, Shantung, China. "(No. 750a, Sept. 4, 1907.) A white cabbage; Chinese name *Ta pai tsay tsun*. A very large variety of the Chinese cabbage, said to grow up to 40 pounds in weight and to be very solid. This variety is largely exported to the south of China." (*Meyer.*)

21626. BRASSICA PE-TSAI. **Pe-tsai cabbage.**

From Tchang-tchou, Chi-li, China. "(No. 751a, Oct. 2, 1907.) A large, long-headed variety of Chinese cabbage; Chinese name *Ta pai tsay*. This variety is somewhat loose in its make-up, but it is able to stand considerable saline matter in the soil. One excellent feature of these cabbages is that they are far easier to digest than our varieties and never emit unpleasant odors when being boiled. As they also withstand heat and dry air to a much greater degree than our varieties, they will probably grow in regions of the United States where ordinary cabbages do not thrive." (*Meyer.*)

21627. NICOTIANA TABACUM. **Tobacco.**

From Yen-tchou-fu, Shantung, China. "(No. 752a, Sept. 4, 1907.) Chinese name *Yen tsun*. A famous variety of tobacco, being exported

21616 to 21639—Continued.

from here to different cities in China; has rather short, though very broad, leaves; grows best on well-drained, irrigated soil and stands alkali remarkably well. It may be a good crop for the irrigated valleys of southern Utah and New Mexico." (*Meyer.*)

21628. CUCUMIS SATIVUS. **Cucumber.**

From Tchang-tchou, Chi-li, China. "(No. 753a, Oct. 2, 1907.) Chinese name *Whang qua.* Is grown in the fields against sorghum-stem trellises. When sown in succession produces cucumbers until the frost kills them. Loves a well-drained soil." (*Meyer.*)

21629. CITRULLUS VULGARIS. **Watermelon.**

From Tai-an-fu, Shantung, China. "(No. 754a, Sept. 11, 1907.) A fine yellow-meated variety of watermelon, considered by the Chinese far superior to the red-meated varieties. Chinese name *Huang si qua.*" (*Meyer.*)

21630. CITRULLUS VULGARIS. **Watermelon.**

From Chinan-fu, Shantung, China. "(No. 755a, Aug. 27, 1907.) A white-meated variety of watermelon, coming later in the season than the red varieties. It is, however, not as sweet as those." (*Meyer.*)

21631. SOLANUM MELONGENA. **Eggplant.**

From Chang-ho, Shantung, China. "(No. 756a, Sept. 29, 1907.) A large-fruited variety of eggplant of a pale violet color. The fruits weigh as much as 7 or 8 pounds apiece, while the plant can resist alkali very well.

"The Chinese pickle these fruits in brine for winter use. Chinese name *Ta cha tse.*" (*Meyer.*)

21632. CAPSICUM ANNUUM. **Pepper.**

From Hsing-chi, Chi-li, China. "(No. 757a, Oct. 3, 1907.) Chinese name *Teng lung tsiao.* A very large fruited variety of Chili pepper, of round oblong shape, dark-red color, and juicy but pungent. Withstands alkali in soil quite well." (*Meyer.*)

21633. MEDICAGO SATIVA. **Alfalfa.**

From Laoling, Shantung, China. "(No. 759a, Sept. 30, 1907.) Chinese name *Mu su tsun.* A rather short-growing variety; said to draw the alkali away from the land; highly prized as a cattle and mule food; sometimes used as a cover crop in jujube orchards; generally left to occupy the land from four to five years. The Chinese grow alfalfa only as a land improver, not directly as a food for domestic animals; the moment the land is fit again for food crops, the alfalfa is dug up." (*Meyer.*)

21634. ZOYSIA PUNGENS. **Korean lawn grass.**

From Laushan Mountains, Shantung, China. "(No. 760a, Aug. 2 and 3, 1907.) A valuable lawn grass, sent formerly from north Korea under Nos. 470a and 471a (S. P. I. Nos. 19425 and 19426). See remarks with these notes. This grass seems to do better in the elevated altitudes than on the burning plains, as it apparently likes cool nights." (*Meyer.*)

21635. POLIANTHES TUBEROSA. **Tuberose.**

From Tientsin, Chi-li, China. "(No. 765a, Oct. 7, 1907.) A red-flowered tuberose; Chinese name *Wan hsian yu.* It seems to be a pale-red variety of the tuberose. The bulbs are taken up in the early part of October, left on the field several days to ripen off and dry, and are then stored in dry, frostproof storerooms." (*Meyer.*)

21636. ASTRAGALUS sp. (?)

From Mong-tchun, Chi-li, China. "(No. 758a, Oct. 1, 1907.) A leguminous plant; Chinese name *Pou tou chiang.* It is grown by the Chi-

21616 to 21639—Continued.

nese as a land improver when the soil is heavily charged with alkali, growing from five to seven years on the land before it is fit again for sorghum, wheat, or beans. It is not liked by cattle, although it is occasionally fed. When killed by the frost, the stems are cut off, dried and bunched, and utilized as fuel. It is also sometimes grown in pear orchards as a cover crop. May be of extreme value to the arid alkaline regions of the United States." (*Meyer.*)

21637. ANTHISTIRIA CILIATA.

From Lung-tung, Shantung, China. "(No. 763a, Sept. 25, 1907.) A tall-growing grass, covering here and there large areas on Chinese burial grounds. It is carefully cut down in autumn, bunched up, and sold for fuel; is probably too coarse for food, but might be grown for paper manufacture in arid regions of the United States." (*Meyer.*)

21638. AGROPYRON sp.

From Tsingtau, Shantung, China. "(No. 761a, July 31, 1907.) A grass found growing along banks and along roads exposed to the sea wind. It seems to be somewhat soil binding." (*Meyer.*)

21639. SPOROBOLUS ELONGATUS.

From Laushan Mountains, Shantung, China. "(No. 762a, Aug. 3, 1907.) A grass growing here and there in clumps between boulders and along trails." (*Meyer.*)

21641 and 21642. PHOENIX DACTYLIFERA. **Date.**

From New York, N. Y. Received from Hills Brothers, December 5, 1907.

21641. *Halawi* (?). From Bassorah, Arabia.

21642. *Fard.* From Muscat, Arabia.

"These dates were used by Hills Brothers in the manufacture of the so-called stuffed dates, and were secured for the purpose of originating varieties adapted to the Southwest." (*Fairchild.*)

21643. LAGENARIA VULGARIS. **Gourd.**

From Pretoria, Transvaal, South Africa. Presented by Prof. J. Burtt Davy, Department of Agriculture. Received December 6, 1907.

Pipe calabash. (For description see S. P. I. No. 19616.)

21644 to 21656.

From Yokohama, Japan. Received from Yokohama Nursery Company (Limited), December 9, 1907.

The following collection of tubers is for experiments with wet-land crops in the South:

21644. COLOCASIA sp.

Hasu-imo.

21645. COLOCASIA ANTIQUORUM ESCULENTA.

Sato-imo.

21646. COLOCASIA ANTIQUORUM ESCULENTA.

Yegu-imo.

21647. COLOCASIA ANTIQUORUM.

Mizu-imo.

21648. COLOCASIA ANTIQUORUM.

Tono-imo.

21644 to 21656—Continued.

21649. COLOCASIA ANTIQUORUM.
Hatake-imo.

21650. SAGITTARIA SAGITTAEFOLIA.
Kuwai.

21651. SAGITTARIA SAGITTAEFOLIA.
Suita kuwai.

21652. DIOSCOREA JAPONICA TUBEROSA.
Kashiu-imo.

21653. DIOSCOREA sp.

21654. DIOSCOREA JAPONICA.
Jinenjo.

21655. DIOSCOREA JAPONICA.
Naga-imo.

21656. DIOSCOREA JAPONICA.
Ichinen-imo.

21657. AMYGDALUS ANDERSONII. **Wild peach.**

From Pyramid Lake, Nevada. Presented by Mr. Marsden Manson, C. E., 2010 Gough street, San Francisco, Cal. Received December 10, 1907.

"These seeds I selected from vigorous and large shrubs or small trees growing on the west side of Pyramid Lake.

"Experiments with these should be to develop:

"(1) As a peach.

"(2) As an almond (the kernel is quite edible).

"(3) By hybridization with both the above, (1) and (2).

"(4) As a stock for (1) and (2)." (*Manson.*)

21658. ARALIA RACEMOSA. **Spikenard.**

From North Clarendon, Vt. Presented by Mr. James Barrett, through Mr. O. W. Barrett. Received December 1, 1907.

"Prefers half shade in moist soil along roads or streams in forests; is seldom found in open situations. It reaches a height of from 3 to 5 feet. The roots are perennial, but the stems die back every winter. Decoctions of the thick aromatic bark of the roots with sugar are used as a catarrhal remedy. The bark is gathered late in the autumn." (*Barrett.*)

"This species being closely related to *Aralia cordata*, the Japanese udo, it seems feasible to try hybrids between the two species with the view of creating a more rapid growing form of the Japanese vegetable." (*Fairchild.*)

"A hardy, herbaceous perennial herb, 3 to 6 feet high, with a large and thick, strongly aromatic root. In general appearance it rather closely resembles the Japanese *Aralia cordata*, except that the leaves usually have three leaflets instead of five and the leaflets are broader in proportion to their length and less hairy." (*W. F. Wight.*)

21659. CASSIA ROBUSTA.

From Biloxi, Miss. Presented by Mr. S. M. Tracy, through Prof. C. V. Piper. Received December 5, 1907.

"This is common in central Mississippi, where it grows as an erect, branching annual, 3 to 5 feet high. It is the largest and most vigorous growing of the 'sensitive plants,' and as it reseeds the ground freely it will probably be of value as a cover and restorative crop for citrus groves and other fields where a rank, summer-growing legume is wanted. Being an annual, it can be eradicated easily by a single plowing at any time during the summer.

"Seed may be sown at any time from December to February, and needs no special treatment." (*Tracy.*)

21660 to 21662. TRIFOLIUM ALEXANDRINUM. **Berseem.**

From Cairo, Egypt. Received from Mr. George P. Foaden, Khedival Agricultural Society, December 10, 1907.

21660. *Muscowi.*

21661. *Fachl.*

21662. *Saidi.*

21663 and 21664.

From Yokohama, Japan. Received from Yokohama Nursery Company (Limited), December, 1907.

21663. EUTREMA HEDERAEFOLIA. **Dry-land wasabi.**

Yuri-wasabi.

See No. 10579, Inventory No. 11, for description.

21664. DIOSCOREA sp.

21666. MUCUNA sp.

From Gasparee Island, Trinidad. Received through Mr. O. W. Barrett, December 14, 1907.

"Found on the rocky hillsides in virgin forests; possibly a Venezuelan species, not seen on the mainland of Trinidad." (*Barrett.*)

21667 to 21683.

From Ichang, Hupeh, China. Collected by Mr. E. H. Wilson, of the Arnold Arboretum, Jamaica Plain, Mass., in cooperation with this Department. Received in November and December, 1907.

21667. TRITICUM VULGARE. **Wheat.**

"(No. 207.) *Hsao mesh.* The hairy red wheat, said to be awned; sown ninth to eleventh moon; ripe fourth to fifth moon. Cultivated at Ichang and in the mountains. Used for making flour." (*Wilson.*)

21668. TRITICUM VULGARE. **Wheat.**

"(No. 208.) *Hsao mesh.* Smooth white wheat, said to be without awns; sown tenth moon (November); ripe fourth and fifth moons (May and early June). Cultivated at Ichang and in the mountains. Used for making flour. This is considered the best wheat in this region." (*Wilson.*)

21669. HORDEUM VULGARE NUDUM. **Hull-less barley.**

"(No. 209.) *Mc mesh.* Sown ninth moon (October); ripe fourth to fifth moons. Cultivated in the mountain regions. Not used for making flour, but ground into coarse meal and made into cakes." (*Wilson.*)

21670. HORDEUM VULGARE NUDUM. **Hull-less barley.**

"(No. 210.) *Mc mesh.* Sown ninth moon; ripe fourth and fifth moons. Cultivated around Ichang and in the mountain region. Used in the same way as No. 209 (S. P. I. No. 21669)." (*Wilson.*)

21671. HORDEUM VULGARE. **Barley.**

"(No. 211.) *Fa mesh.* Sown ninth moon; ripe fourth to fifth moons. Cultivated around Ichang and in the mountains. Used mainly by peasants." (*Wilson.*)

21672. AVENA SATIVA. **Oat.**

"(No. 212.) *Yen mesh.* Sown eleventh moon (December); ripe fourth and fifth moons. A mountain crop; eaten after the manner of porridge; also used for feeding horses." (*Wilson.*)

"A hull-less variety." (*Carleton.*)

21667 to 21683—Continued.

21673. FAGOPYRUM sp. **Buckwheat.**

"(No. 213, Oct. 4, 1907.) *Ku ch'ao.* A green buckwheat which grows 2½ to 4 feet high; used for making cakes. This buckwheat is an important crop in the higher mountains (5,000 to 8,000 feet), where it is cultivated during the summer months; in the Yangtze Valley and in the mountains up to 3,000 feet. It is sown in the twelfth moon (January) and reaped in the fourth and fifth moons. In the neighborhood of Ichang it is often cultivated as a catch crop in the early autumn." (*Wilson.*)

"Translated the word 'Ku ch'ao' means 'early sown.'" (*Carleton.*)

21674. FAGOPYRUM sp. **Buckwheat.**

"(No. 214.) *Hwa ch'ao.* A red buckwheat which grows 1 to 2 feet high; used for making cakes. Fields of this pink buckwheat scattered over the mountain sides constitute when in flower one of the prettiest sights imaginable." (*Wilson.*)

"The word 'Hwa ch'ao' means 'late sown.'" (*Carleton.*) (For further description, see S. P. I. No. 21673.)

21675. RUBUS INNOMINATUS.

"(No. 92.) Sweet or semisweet bramble, 4 to 12 feet. Stems not very prickly, clothed with short, soft pubescence. Leaves 3 to 5 foliate, terminal leaflet often trilobed: under side pale and clothed with short, soft pubescence. Calyx glandular or eglandular. Fruit paniculate, red, of good size and fine flavor; panicle often a foot long. Common in thickets up to 4,000 feet everywhere in western Hupeh. In fruit very ornamental and should, I think, prove a useful plant to the breeder on account of its immense panicles. It is the same as *Rubus kuntzeanus*, Hemsl." (*Wilson.*)

21676. ANDROPOGON SORGHUM. **Sorghum.**

"(No. 260.) A cereal growing 6 to 12 feet high. Pellicles reddish black. Cultivated in valleys and low hills to the south of Ichang." (*Wilson.*)

21677. ANDROPOGON SORGHUM. **Sorghum.**

"(No. 260a.) A cereal growing 6 to 12 feet high. Pellicles black or nearly so. Commonly cultivated in the valleys around Ichang." (*Wilson.*)

21678. ANDROPOGON SORGHUM. **Sorghum.**

"(No. 202.) A cereal growing 8 to 12 feet high. Pellicles dull red or reddish chestnut. Widely cultivated on the alluvial flats between Shasi and Yochow, and more especially around Shasi. It was from the last-named place that the seeds were obtained.

"In this part of the Yangtze Valley the sole use of sorghum (kao-liang) is for making wine and spirits. I can find no record of its being used for food even by the peasants." (*Wilson.*)

21679. LIGUSTICUM sp. (?)

"(No. 262.) *Tu hoa.* Herb 3 to 5 feet high. Flowers white, in large corymbs. Commonly cultivated in the mountains of western Hupeh above 4,000 feet. Roots used in medicine; said to possess stomachic, tonic, carminative, expectorant, and lenitive properties." (*Wilson.*)

21680. LIGUSTICUM sp. (?)

"(No. 262a.) *Tu hoa.* Similar to No. 262 (S. P. I. No. 21679) but with much smaller corymbs and in all probability a different species. Its properties are the same, and I can not find that any distinction is made in the drug shops here.

"The Imperial maritime customs valuation of *Tu hoa* is 700 haikwan taels per picul. Large quantities are exported down the river from Ichang." (*Wilson.*)

21667 to 21683—Continued.

21681. CODONOPSIS TANGSHEN.

"(No. 269, Oct. 31, 1907.) *T'ang shen*, bastard ginseng. A climbing herb, 3 to 6 feet, with bluish purple flowers, greenish without; very abundant in the margins of thickets (sometimes cultivated also), 4,000 to 7,000 feet. Roots supposed to possess valuable tonic properties. Also considered a mild aphrodisiac. For full details see Kew Bulletin No. 1, 1907.

"Vast quantities are exported from Ichang in three grades, valued, respectively, by the Imperial maritime customs at 20, 15, and 10 haikwan taels." (*Wilson.*)

21682. RHUS VERNICIFERA. **Lacquer tree.**

"(No. 123, Sept. 4, 1907.) A tree 25 to 40 feet high, cultivated around the margins of fields between 3,000 and 7,500 feet and in wild woods above 4,000 feet. Branches more or less whorled, ascending at an angle of about 45°. Leaves unparipinnate, five to many foliate, 1 foot to 2½ feet long, clustered at the ends of the branches. Flowers small, greenish white, borne in large, axillary panicles. Fruit small, flattened, straw colored.

"*Rhus vernicifera*, the *Che shu* of the Chinese, is the source of the well-known 'Ningpo' varnish, at least that of central and western China. What the 'Ningpo' plant may be is a matter of doubt, since no specimens have ever been collected there. It is, however, more than likely that 'Ningpo' is merely a trade name adopted by fruit growers in China to signify this particular varnish. Throughout the mountains south of Hupeh the trees are multitudinous, and enormous quantities of varnish are obtained and exported to all parts of China.

"The trees are first cut when about 6 inches in diameter; if too young the cutting kills. The average age of the trees is said to be above 60 years. The wood is useless save for fuel. In the woods the trees naturally grow taller than in the open. The tree is the property of the owner of the land, not of the tenant, and the varnish belongs to the former.

"Cutting the trees commences at the lower altitudes about the 20th of the fifth moon, but is general during the sixth moon. This is the time when the flowers are just opening. Oblique incisions 4 to 12 inches long and one-half inch to 1 inch wide are made in the trunk and main branches in the early morning and the varnish collected in bamboo tubs, shells, broken basins, etc., in the evening. These incisions are more or less spirally arranged along the stems. The varnish exudes for 7 days and then a thin slice of bark is cut away from the edge of the original incision. This is repeated seven times, the whole operation of collecting the varnish lasting about 50 days. The varnish when it first exudes is whitish, but quickly becomes dark almond on exposure to the air. A large tree yields 5 to 7 catties (6⅔ to 9⅓ pounds). This varnish is fit for use as soon as it is gathered, but there are several grades on the market, and it is probable that it subsequently undergoes some kind of preparation.

"The fruits when ground up, steamed, and submitted to pressure yield an oil used for culinary purposes, but more so for candle making. This oil is more abundant in the pericarp than in the seed." (*Wilson.*)

21683. ANGELICA sp. (?)

"(No. 201, Oct. 9, 1907.) *T'ang kuei.* An umbelliferous herb 2 to 3 feet high, with fine dissected decompound leaves, white flowers, and some short, thickened roots. This medicine is plentifully cultivated in the mountains of western Szechuan above 5,000 feet and more sparingly in the mountains of Hupeh around 6,500 feet. It requires deep rich loam and a good supply of manure—pig dung by preference. So far wild specimens are unknown.

"This medicine is in great request among the Chinese, especially in the more southern parts of the Empire. It is said to possess valuable but mild tonic properties.

"At Ichang the customs' valuation is 15 haikwan taels per picul, first class; 9 haikwan taels, second class. Large quantities are exported from here. I am not at all sure of the generic name, and it may be a *Ligusticum*." (*Wilson.*)

21684. ZEA MAYS. **Corn.**

From Lima, Peru. Presented by Mr. T. F. Sedgwick, director, Estacion Experimental, through Mr. David Fairchild. Received December 12, 1907.

"A red corn used to make the national fermented drink, 'red chicha.' The common corn is used for chicha as well, but the color is about like that of fermented cane juice. The coloring matter in the red chicha is obtained chiefly from the cob. This red chicha is greatly liked by the natives and is sold at most fiestas by the laboring classes. I have never heard of its being used for coloring wine, but it is used in coloring gelatine." (*Sedgwick.*)

21688. CAPSICUM ANNUUM. **Pepper.**

From Chico, Cal. Collected in Mexico and presented by Mr. Edward M. Ehrhorn, First Deputy Commissioner of Horticulture, San Francisco, Cal. Grown at the Plant Introduction Garden, season of 1907. Received December 7, 1907.

21689. CITRUS AURANTIUM. **Orange.**

From Algiers, Algeria. Presented by Dr. L. Trabut, government botanist of Algeria. Received December 16, 1907.

Précoce de Kabylie.

21691 to 21693. CUCURBITA MELANOSPERMA. **Ecuador melon.**

From Quito, Ecuador. Presented by Mr. S. Ordonez M. Received December 14, 1907.

21691. Long green shell.

21692. White shell.

21693. Green shell, striped white.

(For description see No. 18328.)

21695 to 21697. CYNARA SCOLYMUS. **Artichoke.**

From Milan, Italy. Received from Fratelli Ingegnoli, December 10, 1907.

21695. *Grosse Italia.*

21696. *Violetto di Provenza.*

21697. *Senza Spine di Venezia.*

21699. PERSEA GRATISSIMA. **Avocado.**

From Lima, Peru. Presented by Mr. T. F. Sedgwick, director, Estacion Experimentale, through Mr. O. W. Barrett. Received December 20, 1907.

21700 to 21702.

From Peking, Chi-li, China. Received through Mr. Frank N. Meyer, agricultural explorer, December, 1907.

21700. CHLORIS VIRGATA.

From Tong-kwan-tun, Chi-li. "(No. 764a, Oct. 3, 1907.) A bad grass. Chinese name *Lu pu tun.* This annual grass overruns whole fields and is a great weed, but it resists alkali to a most remarkable degree and is eaten by all domestic animals. Overruns even alfalfa fields. For trial, without taking responsibility upon myself." (*Meyer.*)

21701. CUCUMIS MELO. **Muskmelon.**

From Hanchau, Chekiang. "(No. 826a, June 27, 1907.) A small but sweet melon growing not much larger than a big apple." (*Meyer.*)

21702. STACHYS AFFINIS. **Crosne.**

From Peking, Chi-li. "(No. 23, Nov. 5, 1907.) Chinese name *Kan lo;* used as appetizers by the better classes of Chinese. They pickle them in brine and serve them as they are. Foreigners stew them and eat them with a milk sauce, just like Jerusalem artichokes." (*Meyer.*)

21703. PHOENIX DACTYLIFERA. **Date.**

From New York, N. Y. Received from Messrs. Reiss & Brady, 349 Greenwich street, December 20, 1907.

Fard.—Seed of this variety secured for propagation in seedling date orchards.

21704 and 21705. PHYSALIS spp.

From Pretoria, Transvaal, South Africa. Presented by Mr. R. A. Davis, government horticulturist. Received December 23, 1907.

21704. PHYSALIS FRANCHETI. **Chinese lantern plant.**

"Was formerly considered poisonous, but is now found to be an edible commodity." (*Davis.*)

21705. PHYSALIS PERUVIANA.

"The variety which is most largely grown here." (*Davis.*)

21706. HARPEPHYLLUM CAFFRUM. **Kafir plum.**

From Cape Town, Cape of Good Hope, South Africa. Received from Mr. Charles P. Lounsbury, entomologist, Department of Agriculture, December 24, 1907.

"This tree has shown itself to be a promising shade tree in southern California." (*Fairchild.*) (For description see No. 9616, Inventory No. 9.)

21707 to 21709.

From district Amraoti, Berars, India. Presented by Mr. Anant Sitaram Dhavale, Nimboli, Post Mangrul-Dhavale, through Prof. C. V. Piper. Received December 27, 1907

21707. SESAMUM INDICUM. **Sesame.**

"*Til.* Both rainy and cold season crop, but the rainy season's crop is often plowed in for wheat sowing." (*Dhavale.*)

21708. PHASEOLUS RADIATUS. **Mung bean.**

"*Urid.* An autumn crop, the most leguminous one and the one most generally plowed in for all the cold-weather crops." (*Dhavale.*)

21709. PISUM ARVENSE. **Field pea.**

"*Muter.* A cold-weather leguminous crop, very rarely plowed in—in case of failure only." (*Dhavale.*)

21710. JUGLANS NIGRA × REGIA. **Walnut.**

From Paris, France. Presented by Mr. Philippe L. de Vilmorin. Received December 24, 1907.

"*Juglans vilmoriniana* Carr. These nuts are rare, of course, as in all hybrids, and one big tree nearly 100 years old bears only 12 to 20 every year. Strange to say, one hybrid breeds true. In some hundred seedlings made in the last years, I have noticed only two or three that are not true." (*Vilmorin.*)

(See also Nos. 19261 and 21612; also Garden and Forest, Vol. IV, p. 51, 1891.)

21711 to 21715.

From Bodoe, Tromsoë, Norway. Received from Mr. L. P. Nilssen, director of the agricultural school and experiment station, through Prof. N. E. Hansen, of the Agricultural Experiment Station, Brookings, S. Dak., as agricultural explorer for the Department of Agriculture in 1906. Numbered December, 1907.

21711 to 21715—Continued.

21711. HORDEUM VULGARE. **Barley.**

"(No. 277.) A barley from Ofoton, 68° 20′, north of the Arctic Circle in Norway, from the innermost point of a deep fjord, or arm of the sea, a few meters above sea level, on sandy soil; severe winter, cold, but usually with snow. This is originally from Lyngen in Tromsoe Amt or province; in a deep fjord, 69° 17′ N. lat., and cultivated fifteen years in succession at Elvegaard, a farm belonging to S. Mosling, where it has ripened every year. The present sample raised by S. Mosling, of Elvegaard, at Ofoton." (*Hansen.*)

21712. AVENA SATIVA. **Oat.**

"(No. 278.) Seed of oats from the same place as No. 277 (S. P. I. No. 21711). Cultivated here one year." (*Hansen.*)

21713. HORDEUM VULGARE. **Barley.**

"(No. 279.) Sample of barley from Hans Olsen Misvaer, in Skjaerstad, in 67° 7′ latitude in northern Norway, in a deep fjord, where the winter is uniformly cold and the summer often oppressively warm; sandy soil. This sample was cultivated for a number of years in succession in the same place. Sowing season about May 20; harvest August 24." (*Hansen.*)

21714. SECALE CEREALE. **Rye.**

"(No. 280.) Spring rye from the same locality as No. 279 (S. P. I. No. 21713)." (*Hansen.*)

21715. SECALE CEREALE. **Rye.**

"(No. 281.) Winter rye from Arnoldus Mo, Bodin, 67° 19′ latitude, northern Norway, a locality on the seacoast, where the fields often lie bare in winter. This sample was cultivated over fifty years on the same place." (*Hansen.*)

21716 to 21730.

From Tashkent, Turkestan, Russian Central Asia. Received from Mr. Richard Schroeder, director of the experiment station, through Prof. N. E. Hansen, of the Agricultural Experiment Station, Brookings, S. Dak., as agricultural explorer for the Department of Agriculture in 1906. Numbered December, 1907.

21716. GOSSYPIUM HIRSUTUM. **Cotton.**

"*Bokhara.* (No. 292.) From the bazaar at Tashkent, Turkestan." (*Hansen.*)

21717. MALUS MALUS. **Apple.**

"*Kisyl alma.* (No. 293.) From Samarcand, Russian Turkestan." (*Hansen.*)

21718. BETA VULGARIS. **Beet.**

"*Muschak-dumalak.* (No. 294.) From Tashkent, Russian Turkestan. Seed of native beet." (*Hansen.*)

21719. CUCUMIS SATIVUS. **Cucumber.**

"*Kok-badrin.* (No. 295.) From Tashkent, Russian Turkestan." (*Hansen.*)

21720. PANICUM MILIACEUM. **Broom corn millet.**

"*Ak-kunak.* (No. 296.) From Tashkent, Russian Turkestan. A native millet." (*Hansen.*)

21721. PRUNUS sp. **Cherry.**

"*Kara-alytscha.* (No. 297.) From Tashkent, Russian Turkestan. A native cherry." (*Hansen.*)

21716 to 21730—Continued.

21722. PANICUM MILIACEUM. **Broom corn millet.**

"*Bulbul-kunak.* (No. 298.) From Moha, via Tashkent, Russian Turkestan. A red millet." (*Hansen.*)

21723. PRUNUS sp. **Plum.**

"*Kara-alkhor.* (No. 299.) From Tashkent, Russian Turkestan. A native plum." (*Hansen.*)

21724. PANICUM MILIACEUM. **Broom corn millet.**

"*Tschiljaki-taryk.* (No. 300.) From Tashkent, Russian Turkestan. Seed of a native white millet." (*Hansen.*)

21725. PISTACHIA sp. **Pistache.**

"*Pandi-psta.* No. 30L.) From the bazaar at Tashkent, Russian Turkestan. Seeds of a native pistache nut." (*Hansen.*)

21726. ZEA MAYS. **Maize.**

From Kutais, Transcaucasia, Asiatic Russia. "(No. 302.) A hybrid maize." (*Hansen.*)

21727. PRUNUS sp. **Cherry.**

From the bazaar at Bokhara, Russian Turkestan. "(No. 303.) Seeds of the native cherry." (*Hansen.*)

21728. PRUNUS ARMENIACA. **Apricot.**

"*Urjuk.* (No. 304.) From Tashkent, Russian Turkestan. Seeds of native apricot. Very large pits and fruits." (*Hansen.*)

21729. ANDROPOGON SORGHUM. **Sorghum.**

From Tashkent, Russian Turkestan. "(No. 305.) Seed of native forage plant, *Sorghum cernuum*, one of the best native varieties." (*Hansen.*)

21730. CUCUMIS MELO. **Muskmelon.**

"*Bass-waldy.* (No. 306.) From the bazaar at Tashkent, Russian Turkestan. Seed of native muskmelon. The present sample is dried in the flesh. The natives claim this is the only way these muskmelons, which ripen during the winter like winter apples, should be kept." (*Hansen.*)

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O

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 133.

B. T. GALLOWAY, *Chief of Bureau.*

PEACH, APRICOT, AND PRUNE KERNELS AS BY-PRODUCTS OF THE FRUIT INDUSTRY OF THE UNITED STATES.

BY

FRANK RABAK,
EXPERT, DRUG-PLANT INVESTIGATIONS.

ISSUED OCTOBER 26, 1908.

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1908.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., June 18, 1908.

SIR: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 133 of the series of this Bureau, the accompanying manuscript, entitled "Peach, Apricot, and Prune Kernels as By-Products of the Fruit Industry of the United States."

This paper was prepared by Mr. Frank Rabak, Expert in Drug-Plant Investigations, working under the direction of Dr. Rodney H. True, Physiologist in Charge, who submits this manuscript with a view to publication.

There has been some demand for information along this line from fruit growers, who have recently felt the desirability of working up all products capable of being made a source of profit. In view of the fact that the oils obtained from these kernels are practically identical with those now imported from foreign sources, a fact which is shown in the accompanying bulletin, it seems clear that the information here submitted will meet with a welcome not only from the fruit men but also from the importers of the products concerned.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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PEACH, APRICOT AND PRUNE KERNELS AS BY-PRODUCTS OF THE FRUIT INDUSTRY OF THE UNITED STATES.

BOTANICAL INTRODUCTION.

The natural order Drupaceæ supplies a large number of edible fruits, many of which are grown and marketed commercially on a large scale. Among these the peach, the apricot, and the prune are important.

The apricot is a native of Turkestan and China, though deriving its species name, *Amygdalus armeniaca* L. (*Armeniaca vulgaris* Lam., *Prunus oleoginosa* Desf.), from Armenia, formerly considered its native country. In the United States it is grown for the most part west of the Rocky Mountains.

The peach is also of foreign introduction and is known botanically as *Amygdalus persica* L. (*Persica vulgaris* Mill., *Prunus persica* Benth. and Hook., *Malum persicum* Plinius).

The origin of the peach has been traced to China, though most of the varieties grown in Europe and America prior to the last half century were derived from Persian stock. It is very widely distributed in the United States, being largely grown in California, Colorado, Michigan, Georgia, Missouri, Arkansas, Texas, Delaware, Maryland, West Virginia, New Jersey, and other States.

Of the half dozen species of plums that are commercially grown in the United States the common prune of the market is most important. Though widely distributed, the prune is most largely grown in California, Oregon, Washington, and Idaho, and represents fruit of a few varieties of *Prunus domestica* L.

Near relatives to the species just described are those which bear the sweet and bitter almonds of commerce. The sweet almond is the seed of *Amygdalus communis dulcis* DC., while the bitter almond is designated as *Amygdalus communis amara* DC.

The almond is a native of Africa and the East, but now grows wild in all parts of southern Europe. It has been introduced into California, where the climate seems peculiarly adapted to its growth. While the tree thrives in most of the peach districts, its early-blossoming habit renders it susceptible to injury by spring frosts.

The principal articles of commerce from the almond tree are the kernels from the fruit, both the bitter and the sweet varieties being imported in large quantities from France, Spain, Italy, and the Levant.

The principal products of the genus Prunus are the fruits, which form a very important article of commerce in the United States, as well as in foreign countries. The fruits of the peach, prune, and apricot are produced in large quantities in different portions of the United States, the peach being more generally grown than the apricot and prune, both of which are most largely planted on the Pacific slope, and especially in California.

The production of the three fruits mentioned has assumed considerable proportions within recent years, as is in a measure indicated by the total exportation of these commodities. During the year 1906 there were exported from the United States for foreign consumption 13,760,281 pounds of apricots, with a total valuation of $1,325,422; peaches, 1,181,649 pounds, with a valuation of $110,407; and prunes, 24,869,744 pounds, with a valuation of $1,410,636.[a] These statistics cover simply the dried fruit, no data as to the fresh and canned products being available.

In the course of preparation for the market and before exportation, the apricots and peaches undergo the process of pitting, by means of which the pits or stones are removed from the fruits, while the pitting of dried prunes has been only recently undertaken in a commercial way.

The kernels of the sweet and bitter almonds form, as already stated, important commercial articles. The kernels of both were formerly used in the manufacture of the fixed oil of almonds. In late years the sweet almond has been almost entirely supplanted by the bitter form because of the much lower price of the latter. Both sweet and bitter almonds are also used extensively by confectioners. The fixed oil expressed from bitter almonds is practically identical in composition with that from sweet almonds; and, furthermore, since the press cake from the bitter almond forms a basis for the preparation of the essential oil of almonds, it is used in preference to that of the sweet almond. Both the fixed and volatile oils of almonds are important pharmaceutical articles, the fixed oil being used very largely in the manufacture of emulsions, soaps, ointments, etc., while the bitter almond oil is prized therapeutically largely on account of its sedative action and because it is a suitable and convenient means for the introduction of the very poisonous hydrocyanic acid into remedial agents.

[a] Commerce and Navigation of the United States, 1906, pp. 596–597.

The pitting process, which is applied to the fruits of peaches, apricots, and prunes, yields great quantities of pits or stones. The uses to which these pits have been put heretofore place them in the category of waste products or, in some cases, by-products. Apart from their use as a fuel, the majority have been discarded, with the exception that a certain quantity of apricot pits have been marketed and some peach pits have been sold to nurserymen.

In view of the extensive use of almond kernels in commerce and considering the exceedingly close botanical relation of the peach, apricot, and prune seeds to those of the almond as well as the similarity of composition, there is seemingly no definite reason why the kernels of these three fruits should not demand attention with reference to their possible commercial value.

The purpose of the investigation reported upon in these pages has been to bring about not only a clearer understanding of these kernels with special reference to their likeness to almond kernels, but also to compare chemically the commercial products obtainable from the kernels.

Owing to the very close relationship existing between the kernels of these various fruits and since the commercial products capable of separation from these kernels are of sufficient importance, a new commercial resource suggests itself in the utilization of these waste pits and kernels.

THE RELATION OF PEACH, APRICOT, AND PRUNE KERNELS TO SWEET AND BITTER ALMONDS.

PHYSICAL RELATIONSHIP.

In physical appearance the close similarity between the kernels of the peach, apricot, and prune and those of the sweet and bitter almonds stands out very prominently. They are produced by plants belonging to the same family, the Drupaceæ, and in fact by plants belonging to very closely related genera. All produce a fruit drupaceous in character, with a fleshy pericarp or sarcocarp surrounding the pit. The character of the fleshy portion of the fruit, as well as the external appearance, differs materially, as does also the external appearance of the pit, but the kernels within the pit have the close resemblance that the trees bear to each other, differing chiefly in size.

CHEMICAL RELATIONSHIP.

Chemically the kernels of the peach, apricot, and prune bear, even to a much greater degree than in physical appearance, a close similarity to the sweet and bitter almonds, and especially to the latter.

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The composition of bitter almonds is approximately as follows:[a] Fixed oil, 46 per cent; mucilage, 3 per cent; sugar (mostly dextrose), 6 per cent; proteids (including emulsin), 24 to 30 per cent; amygdalin, 1 to 3 per cent; and about 3 to 5 per cent of ash. It is well known that bitter almonds can be made to yield prussic acid (hydrocyanic acid) by simple maceration of the crushed seeds in water. It was formerly supposed that the hydrocyanic acid was contained in the seeds, but Robiquet and Boutron-Charlard[b] in 1830 discovered that this principle does not preexist in the seed of the almond and is not formed until water is present. These investigators discovered a crystalline substance in the almond which was termed amygdalin and which belongs to a class of plant constituents known as glucosides. Glucosides have the property when decomposed or hydrolysed by a ferment or dilute acid or alkali to yield dextrose (or an allied sugar which is constant) and some other compound which is not constant, but which possesses a definite composition. It may therefore be stated that when the two important constituents of the bitter almond, the glucoside amygdalin and the ferment emulsin, are made to interact by the addition of water, the following compounds result as products of the hydrolysis: Dextrose, hydrocyanic acid, and benzaldehyde. The reaction is as follows:

$$\underset{\text{amygdalin}}{C_{20}H_{27}NO_{11}}+2H_2O=\underset{\text{hydrocyanic acid}}{HCn}+\underset{\text{benzaldehyde}}{C_6H_5CHO}+\underset{\text{dextrose}}{2C_6H_{12}O_6}.$$

The emulsin, as will be observed, takes no quantitative part in the reaction, but in the presence of water simply acts as a catalytic agent, causing the decomposition of the amygdalin, as shown in the above reaction.

The hydrocyanic acid and benzaldehyde comprise what is known in commerce as the volatile oil of bitter almonds. It is therefore evident that the chief constituents of bitter almonds are the fixed oil, the amygdalin, and the proteids, including emulsin.

The composition of the kernels in question—those of the peach, apricot, and prune—is practically the same as that of bitter almonds, only a slight variation existing. The percentages of fixed oil and amygdalin (which is an important constituent for the production of volatile oil) in the seeds compare very favorably with the quantities of the same constituents found in a commercial sample of bitter almonds. These comparative results are shown under the discussions of the fixed and volatile oils. No doubt remains, therefore, that commercial products similar to those produced from the bitter-almond kernels may be produced from the kernels of the peach, apricot, and prune.

[a] National Dispensatory, 1905, p. 163.

[b] Annales de Chimie; Jour. of Pharm., 1833, p. 67.

COMMERCIAL PRODUCTS FROM KERNELS OF THE PEACH, APRICOT, PRUNE, AND ALMOND.

By proper manipulation of the kernels from the peach, apricot, prune, and almond, there may be produced (1) the fixed oil and (2) the volatile oil.

The fixed oil obtained by expression of the sweet and bitter almond kernels constitutes a very important article of commerce. Owing to the consistent high prices of the crude material, however, the fixed oil has ceased in a large measure to be prepared from the almond kernel, which has been replaced by cheaper materials, such as apricot and peach kernels.

As early as 1888[a] a fixed oil was expressed commercially from peach and apricot kernels. It was also extracted on a large scale in the temperate belt of Asia, between east Hindustan and Persia, from apricot and peach seeds.[b] Owing to the rapid displacement of almond oil by oils made from other kernels, much attention was given to the growth and production of apricots and peaches in European and Asiatic countries, growers in the vicinity of Damascus and Syria being especially active in the production. From the former locality there were exported in 1889[c] as much as 575,000 kilos of kernels, and from Syria in 1895[d] about 300,000 kilos, mostly to Europe, where the fatty oil was expressed. Schimmel & Co.[e] reported in 1889 that the fixed oil of almonds was generally represented on the market by peach-kernel oil. The substitution of peach-kernel oil for the true almond oil has been greatly minimized by the enforcement of the Federal and State food laws.

The production of fixed oils had up to this time (1889) been confined entirely to foreign-grown apricot and peach kernels. A shortage of crops or possibly a greater demand introduced a new factor into the situation. The California production was unusually large, and the kernels had found no market and were considered as useless by-products. The coincident shortage in Europe caused considerable consignments of the apricot kernels to be shipped from the United States,[d] principally from California; and, since peaches are also grown in enormous quantities, the kernels from the peach pits gradually entered the same channels, and in 1900[f] about 40,000 kilos were exported to Europe.

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[a] Ber., Schimmel & Co., April, 1888, p. 26.

[b] Maben, Thomas. Pharm. Jour. & Trans., vol. 16, p. 797. 1886.

[c] Pharm. Jour. & Trans., vol. 20, p. 856. 1889–90.

[d] Rept., Schimmel & Co., April, 1897, p. 5.

[e] Ber., Schimmel & Co., October, 1889, p. 34.

[f] Rept., Schimmel & Co., April, 1900, p. 4.

Owing to the vast inroads made by these products upon the production of almond oil, an oil for the market was produced either from apricot or peach kernels, depending upon the relative market value of each, apricots being as a rule cheaper. The oil almost without exception was produced from apricots.[a]

Later, oil of sweet almonds became almost a rarity, being prepared only to a small extent from bitter almonds. It was asserted that for every pound of this oil imported at least 100 pounds of peach or apricot kernel oil were also imported.[b]

The adulteration of oil of almonds with apricot-kernel oil is mentioned as early as 1866,[c] and now the adulteration has been transformed into almost a total replacement[d] of the true oil by the oil from these kernels.

The volatile oil of bitter almonds was reported as being manufactured from seeds of the apricot imported into France from Asia Minor in 1877.[e] Somewhat later it was declared that the chief raw materials[f] for the manufacture of bitter-almond oil were peach and apricot kernels, this statement being reconfirmed in 1901[g] by the assertion that bitter-almond oil from bitter almonds was rarely met with in commerce, but was represented by the volatile oils from apricot and peach kernels, there being not the slightest difference between the oils.

In 1903 and 1904[h] the principal raw material was Syrian apricot kernels, which could be purchased very favorably; nevertheless, the demand exceeded the output, and the California kernels were again drawn upon.

Inasmuch as both fixed and volatile oils can be prepared and are prepared from peach and apricot kernels, and, furthermore, since the demand at most times seems to equal and in some cases exceed the supply, the question of the manufacture of these commodities in the United States, where so much raw material is available, presents itself as one of importance.

It has been pointed out that the present commercial supply of these oils is derived from European countries, where the products are manufactured principally from kernels of foreign production, but to some extent from kernels produced in America. The enormous output of fruits from the peach, apricot, and prune orchards in the United States has been alluded to in the foregoing pages; also the fact that

[a] Umney, J. C., and Swinton, R. S. Brit. Pharm. Conf., 1899, p. 444.
[b] Pancoast, G. R., and Kebler, L. F. Amer. Jour. Pharm., vol. 74, p. 495. 1902.
[c] Nickles, M. J. Chem. Centralbl., 1866, p. 557; Jour. de Pharm., 1866, p. 332.
[d] United States Dispensatory, 19th ed., p. 832.
[e] Amer. Jour. Pharm., vol. 49, p. 421. 1877.
[f] Ber., Schimmel & Co., October, 1889, p. 34.
[g] Rept., Schimmel & Co., April–May, 1901, p. 9.
[h] Rept., Schimmel & Co., April–May, 1904, p. 7.

in conjunction with this large production of fruit there are produced immense quantities of the kernels which form the chief raw material for the manufacture of the fixed and volatile oils of almonds.

Neither fixed nor volatile oils are produced in the United States from these kernels to any extent, the consumers depending almost entirely upon foreign production.

Since the oils from the kernels of the peach, apricot, and prune are closely related and allied to the corresponding oils from the sweet and bitter almonds, the following work was undertaken with a view to studying the oils and their properties. It must not be inferred that the object is to encourage adulteration or substitution, but the similarities and dissimilarities which exist between the oils from these kernels and those from kernels of almonds will be shown. Conclusions may then be deduced concerning the real merits of each individual oil.

THE FIXED OIL.

METHODS OF EXTRACTION.

Two methods are at the present time in use for the extraction of fixed oils on both a large and a small scale. Extraction by pressure is possibly made use of more extensively than any other method. For this purpose hydraulic presses are usually employed, consisting essentially of a pump for furnishing the necessary pressure and a pressing box to which the pressure is imparted and in which is placed the material to be pressed. Usually, in pressing seeds such as those of the peach, apricot, or prune, a press so constructed as to allow of warming the pressing plates is employed, thus insuring a more thorough expression of the oil and consequently a higher yield. Judgment must, however, be exercised in order to prevent a deterioration in the quality of the oil, which is very likely to occur if excessive heat is applied.

For more detailed information on hydraulic presses and their application, reference may be made to such works as Schaedler, Die Technologie der Fette und Oele des Pflanzen- und Thierreichs; Lewkowitsch, Chemical Technology and Analysis of Oils, Fats, and Waxes, 2 volumes; and Hefter, Die Technologie der Fette und Oele.

The method of extraction with organic solvents is also employed commercially, large extractors of various construction being used for the purpose. The media used for extraction comprise a certain class of organic compounds which have the property of dissolving fats and oils. Among them may be mentioned carbon disulphid, ether, chloroform, benzine and petroleum ether. Each solvent possesses its characteristic advantage and also disadvantages. Some may be recommended for their comparative cheapness and others on account

of their less inflammable nature and better extracting powers. Any of the solvents used for extraction purposes may be recovered by proper means and again utilized for the same purpose, the expense being thereby reduced to the minimum.

The form of apparatus varies somewhat for each individual solvent. Generally, however, extractors are constructed of suitable metal, preferably copper, and consist essentially of the extractor, the condenser, and the receiving vessel. The theoretical underlying principle is that of continuous extraction, heat being applied preferably in the form of steam (thus reducing danger from inflammability) to the receiving vessel containing the solvent, thus vaporizing the solvent, which in turn is condensed by a proper condensing device placed in such a position that the condensed solvent percolates through the material, carrying with it in solution the fixed oil. The solution of the fixed oil flows into the receiver, where the solvent is again vaporized and condensed, thus completing the cycle. Heat is constantly applied, so that the process becomes a continuous one. More detailed information may be derived from the references already cited.

An accurate estimate of the expense required for the installment of either hydraulic presses or an extraction apparatus can not be given, the price varying naturally with the size of the plant and the output desired. It may be stated, however, that such apparatus once installed has an indefinite period of usefulness with only the expense of operation.

EXTRACTION OF THE FIXED OILS AND LABORATORY DATA OF PHYSICAL PROPERTIES.

In order to confirm some of the earlier statements concerning the fixed oils obtained from such seeds as those of the peach, apricot, prune, and almond, and for the sake of comparison both physically and chemically, a series of laboratory experiments was carried out on several samples of such kernels obtained from different sources.

Peach, apricot, and prune kernels were obtained from various California packing houses, and sweet and bitter almonds were purchased on the market as United States Pharmacopœia articles. The genuineness of the California kernels can not be doubted; belief in the genuineness of the sweet and bitter almonds purchased on the open market rests on the statement of the supplying firm that they were imported seeds coming from Valencia, Spain, and from Italy, respectively.

Sufficient quantities of peach, apricot, prune, and sweet and bitter almond kernels were subjected to extraction with ether in a Soxhlet extraction apparatus, which in principle is identical with the large continuous extractors used commercially.

The percentage yield of fixed oils after complete evaporation of the solvent in each case, together with the other physical properties, is shown in Table I. For purposes of comparison the results obtained by a foreign investigator in the case of peach, apricot, and prune kernels are included.

TABLE I.—*Character and yield of fixed oils obtained from various fruit kernels.*

Sample.	Yield of oil.	Specific gravity.	Color.	Odor.
	Per cent.			
Peach kernels (California)	39.5	[a] 0.9166	Yellow	Fatty, nearly odorless.
Apricot kernels (California)	40	[a] 0.9168	Straw-colored	Slightly fatty, nearly odorless.
Prune kernels (California)	35	[a] 0.9164	Golden yellow	Fatty, with nut-like odor.
Sweet almonds (Valencia, Spain)	49	[a] 0.9162	Light yellow	Nearly odorless, fatty.
Bitter almonds (Italy)	42.3	[a] 0.9158	Yellow	do
Sweet almonds (oil purchased on market).	....	[a] 0.9160	do	do
Apricot kernels (foreign) [b]	40 to 45	[c] 0.915	Nearly colorless, becoming yellow.	Resembles oil of almonds.
Peach kernels (foreign) [b]	30	[d] 0.916	Clear and yellow	do
Prune kernels (foreign) [b]	25 to 30	[c] 0.9127	do	Agreeable; almond-like.

Sample.	Taste.	Congealing point.	Soluble in—
Peach kernels (California)	Bland, fatty, nut-like.	Clear, but viscid at $-16°$ C.	Ether, chloroform, benzine; partly in alcohol.
Apricot kernels (California)	Fatty and nutty	do	Do.
Prune kernels (California)	Bland, fatty, nutty, slightly sweet.	do	Do.
Sweet almonds (Valencia, Spain)	Nut-like and fatty	do	Do.
Bitter almonds (Italy)	Bland and fatty	do	Do.
Sweet almonds (oil purchased on market).	do	do	Do.
Apricot kernels (foreign) [b]	Mild and agreeable	Clear, but viscid at $-14°$ C.	
Peach kernels (foreign) [b]	Resembles oil of almonds.	Clear, but viscid at $-18°$ C.	
Prune kernels (foreign) [b]	Agreeable; almond-like.	Viscid at $+4°$ C.; congeals at $-8.75°$ C.	

[a] At 25° C.
[b] According to Schaedler, Die Technologie der Fette und Oele des Pflanzen- und Thierreichs, pp 537-539.
[c] At 15° C.
[d] At 20° C.

The percentage yields of oils in the several cases, although varying to a certain extent, are amply sufficient to warrant extraction commercially. Sweet and bitter almonds contain a slightly higher percentage of fixed oil, which is especially noticeable in the case of sweet almonds.

The specific gravities of the oils examined are practically identical, the greatest difference being but 0.001, which is within the limit of experimental error. As a rule the specific gravities of oils bear some relationship to their composition.

The color, odor, and taste, as well as the congealing temperature and solubility, reveal no broad differences. The congealing point, being a factor which might be materially influenced by any great differences in composition, is especially useful in the detection of adulterations with oils of an entirely distinct type. None of the oils congealed at $-16°$ C., remaining clear and viscid, the observations differing on this score from those made abroad.

Considering all points of similarity and dissimilarity in the physical properties of the fixed oils from these kernels, any line of demarcation which might be drawn seems rather obscure, the physical properties of the almond oils being so minutely varied as not to indicate any radical variation in composition.

CHEMICAL EXAMINATION.

With a view to making a chemical comparison of the oils, several of the more important so-called chemical constants were determined for each of the oils of peach, apricot, prune, and sweet and bitter almond kernels. For purposes of better illustration, these chemical constants are presented in Table II, thus facilitating a ready means of discrimination between the individual members.

TABLE II.—*Chemical constants in oils obtained from various fruit kernels.*

Source of oil.	Free fatty acids.		Saponification number (Koettstoerfer number).	Iodin absorption (Hubl's number).
	Acid number.	Calculated as oleic acid.		
		Per cent.		
Peach kernels (California)	0.83	0.418	187	110
Apricot kernels (California)	0.75	0.38	203	107
Apricot kernels (same as above, 1 year old)	13.3	6.68	180	118
Prune kernels (California)	1.9	0.955	160	105
Sweet almonds (Valencia, Spain)	0.61	0.32	170	106.8
Bitter almonds (Italy)	1.7	0.86	188	106.3
Sweet almonds (purchased on market)	3.5	1.76	193	107.3

FREE FATTY ACIDS.

The free fatty acids of an oil, although not an indication of its value, are nevertheless an index of age or rancidity and hence become a partial factor in the qualitative valuation of a fixed oil.

Almost without exception, unless the strictest precautions are observed to protect an oil from light and air, the free fatty acids increase with the age of the oil. Even an oil kept in partially filled bottles or containers will be acted upon by the oxygen of the air inclosed, with the aid of light, producing a liberation of free acid; or, in other words, the glycerin esters of fatty acids suffer decomposition with the liberation of the free acid and glycerin.

The free fatty acids were determined by neutralizing carefully a weighed quantity of the oil mixed with alcohol with N/10 potassium hydroxid V. S. and noting the number of cubic centimeters of the alkali consumed, using phenolphthalein as an indicator.

The number of milligrams of potassium hydroxid consumed by one gram of the fixed oil represents the acid number of the oil. From the amount of potassium hydroxid consumed the percentage of oleic acid which that amount represents was calculated from the oleic acid factor (1 c. c. N/10 KOH=.0280 gm. oleic acid).

By reference to Table II the fact that all fresh oils possess but little acidity is clearly evident, as the fresh oils from peach, apricot, and prune kernels and the sweet and bitter almond oils show a minimum of 0.32 per cent and a maximum of 0.955 per cent of free acid calculated as oleic acid. Noteworthy here, also, is the abnormally high acidity of the apricot oil taken after standing for a period of one year in a half-filled bottle and only fairly protected from light, the acidity having been multiplied by 17.5. Attention is also called to the acidity of the sweet almond oil purchased on the market, which possesses about five times the acidity of the freshly extracted oil and which serves in a measure to indicate that the oil was slightly aged.

The percentages of free acid in the oils freshly extracted from peach, apricot, and prune kernels, as may be seen, vary but slightly from those of the oils of either sweet or bitter almonds, which seems to indicate that as far as free acidity is concerned they are comparable to a high degree.

SAPONIFICATION VALUE.

The saponification value of a fatty oil, while not expressing a direct measure of the quality of an oil, does become an important and influential factor in the judgment against other oils and as a basis of comparison of several fatty oils.

The saponification numbers, or Koettstoerfer numbers, were determined according to the method prescribed by the United States Pharmacopœia,[a] which consists in heating on a water bath for a half hour a weighed quantity of oil with a measured volume of alcoholic potassium hydroxid and titrating back the excess of alkali by means of half-normal hydrochloric acid. In this manner the amount of potassium hydroxid decomposed by reaction is readily calculated. The saponification number represents the number of milligrams of potassium hydroxid required to saponify completely the fatty acid esters or glycerids in one gram of oil.

[a] United States Pharmacopœia, eighth revision, p. 535.

Peach, apricot, and prune kernel oils compare, as may be seen, more or less favorably with the oils from sweet and bitter almonds in saponification values. The oil from prune kernels shows a value somewhat lower than the several other oils, the sweet almond oil being most nearly associated with it, while, on the other hand, peach kernel and bitter almond oil are practically identical in saponification values. The oil of apricots is slightly above and in fairly close relationship to the sweet almond oil purchased on the market.

The United States Pharmacopœia[a] requires for the expressed oil of almonds a saponification equivalent of 191 to 200, the oil of the market examined being the only oil besides the apricot falling within the requirement, the remaining oils being below the requirement.

Although no preference can be given to an oil on account of the saponification equivalent, it tends to show that the composition of the oils are related at least in the percentage of saponifiable glycerin salts of fatty acids.

IODIN ABSORPTION.

Of somewhat greater significance is the power of a fatty oil to absorb iodin, usually termed iodin absorption or iodin number. The iodin number represents the percentage of iodin absorbed by a fatty oil under certain conditions. The iodin value is dependent upon the amount of unsaturated fatty acids in the oils. The most common unsaturated acid occurring in animal or vegetable oils is oleic acid, which is present in the oil only to a small extent as the free acid, but generally as the glycerid olein. These unsaturated fatty acids or glycerids combine directly with iodin or bromin, and upon this property is based the method employed so extensively in the quantitative examination of fixed oils. The iodin number is therefore a measure of the unsaturated acids present in a fixed oil.

The iodin absorption power was determined according to the United States Pharmacopœia,[b] the principle of the method depending upon the absorption of iodin by the oil, the amount taken up being determined by titration of the excess by means of N/10 sodium thiosulphate V. S.

The iodin values of the various oils indicate a close relationship to the almond oils. The oil from apricot and prune kernels and the three almond oils are very similar, whereas the peach oil indicates only a slightly higher percentage of unsaturated fatty acids.

It is of interest to note at this point that the apricot oil after being aged for one year shows an increase in iodin number, indicating that the amount of unsaturated acids has increased while the saponification value has decreased, owing possibly to the liberation of a considerable amount of free acids.

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[a] United States Pharmacopœia, eighth revision, p. 307.

[b] United States Pharmacopœia, eighth revision, p. 527.

REACTIONS TOWARD REAGENTS.

Of lesser importance in the judging of some fixed oils is their behavior toward reagents. One of the principal tests recommended by the United States Pharmacopœia for distinguishing oil of almonds from peach and apricot kernel oils is what is known as the elaidin test,[a] which depends on the reaction of nitric acid upon the olein of the oil, forming a polymerized, yellow, viscous compound, *elaidin*.

Inasmuch as fixed oils are known to give characteristic color reactions with certain reagents, a comparison of the colors produced with a few reagents was made, as shown in Table III. It is of course to be borne in mind that color reactions are no absolute index of the quality of a fatty oil, but serve only as a means of comparison.

TABLE III.—*Color reactions with certain reagents upon fixed oils obtained from various fruit kernels.*

Source of oil.	Nitric acid.	Nitric acid fuming.	Sulphuric acid.	Sulphuric acid + nitric acid.	Elaidin test.
Peach kernels (California).	Pink........	Yellowish red.	Dirty gray to green.	Brown......	Grayish green. Yellow green mass after standing.
Apricot kernels (California).	Reddish....	Reddish....	Yellowish to brownish red.	Dark brown	Grayish green. Pulpy yellowish brown mass after standing.
Prune kernels (California).	Light reddish.	.....do......	Yellowish to reddish.	Red brown.	Gray green. Light brown green mass after standing.
Sweet almonds (Valencia, Spain).	Pink........	Yellowish red.	Dirty green...	Deep red brown.	Bluish green. Yellow green and solid after standing.
Bitter almonds (Italy).	.....do......	.....do......	.....do........	Brown......	Bluish green mass. Yellow green and solid after standing.
Sweet almonds (purchased on the market) [a]	Faint pink..	.....do......	.....do........	Deep red brown.	Bluish green. Olive green mass after standing.

[a] Purchased as United States Pharmacopœia almond oil.

The color reactions, as shown by the above tabulation, reveal some differences in the oils, although in most cases they are rather trifling. The elaidin test, on the other hand, instead of disclosing characteristic differences shows to a great extent similarities in the oils. As has been previously stated, the color reactions form no basis of declaring any superiority but illustrate rather forcibly the kinship existing in the oils under consideration.

COMPARISON WITH ALLIED FIXED OILS.

While it is impossible to assert from a careful scrutiny of the above data that the oils of peach, apricot, and prune kernels are in every way equal to those obtained from almonds, it is reasonably safe to state that the oils are not radically different from them. The botanical and physical similarities of the trees and their products are substantially upheld by the exceedingly close similarity from a chemical

[a] United States Pharmacopœia, eighth revision, p. 307.

viewpoint. The differences observed are, however, not sufficiently marked to justify a statement of superiority of one over the other.

In all cases the range of differences is comparatively small and only in the prune-kernel oil are the chemical constants at all noticeably dissimilar. The fact that the prune-kernel oil behaves slightly unlike the other members can no doubt be accounted for from the fact that, according to the statements of the suppliers of these kernels, the prunes are subjected to heat during the process of pitting or before. This is necessary because of the difficulty which is experienced in separating the fleshy sarcocarp from the pits. The application of this heat, even if not excessive, would be injurious in its action on the fixed oil in the seeds.

The relationships, both physical and chemical, between the fixed oils from apricot, peach, and prune kernels and the oils of almonds, bitter and sweet, are of the closest, and in several instances the oils practically coincide with each other. Just where a dividing line could be drawn is rather obscure. It therefore seems entirely reasonable, in view of these likenesses, to use these fixed oils in the same manner as the oils obtained from the sweet and the bitter almond.

COMMERCIAL VALUE.

In commerce the oils of almond kernels and also the oils of peach and apricot kernels are used extensively both in the arts and in medicine, and in fact are often employed interchangeably.

Medicinally or pharmaceutically the oils are useful in the preparation of ointments, liniments, emulsions, and other preparations; also as vehicles for the administration of other medicinal agents. McWalter[a] states that therapeutically or pharmacologically there is no distinction between the oils from peach and apricot kernels and the almond oils. Therapeutical differences, however, do exist between the almond, peach, and apricot kernel oils on the one hand and the oils from an entirely distinct source, such as rape, sesame, etc., on the other. Almond, peach, and apricot oils are sweet, nonacrid, nonacid, and yet easily saponifiable and emulsifiable, and are therefore especially suited to certain uses.

The oil of prune kernels has never reached the market owing to its undeveloped production; but there seems no reason why, as a close relative to the almond, peach, and apricot oils, its use should not become commercial also, provided the pitting of prunes becomes general, with a consequent ample supply of pits.

It may also be remembered that owing to the adulterations with unrelated oils to which almond oils are subjected because of their

[a] McWalter, J. C. Pharm. Jour., vol. 74, p. 181. 1905.

high prices, their activity and use are unquestionably hampered. The almond oils, although no doubt still adulterated with peach and apricot kernel oils, have been in a measure entirely replaced by the substitution of these oils. When adulterated with or replaced by peach and apricot oils, their use and action are not so seriously affected, but when adulterated with such oils as rape, cotton, sesame, poppy, olive, and arachis,[a] of entirely different composition, it is almost certain that contrary action and effects must be produced.

Important uses of the oils lie possibly in their great value in the preparation of toilet soaps and cosmetics. Experiments have been made in utilizing the fixed oils [b] (expressed from peach and apricot kernels) in the preparation of high-grade soaps with very satisfactory results, complete saponification, formerly a disputed point, being obtained. Hobein [c] states that almond oil makes excellent toilet soaps, which impart a most agreeable action to the skin. Schimmel & Co.[d] state that owing to the low prices at which peach-kernel oil can be offered, it has attracted much attention in the toilet-soap industry.

The present wholesale prices [e] of oil of sweet almonds (true) is from 45 to 55 cents a pound, while peach-kernel oil is listed at from 28 to 36 cents a pound. Apricot and prune kernel oils are not on the lists, the latter because it has never been produced commercially as yet, and the former being possibly sold as sweet-almond oil.

Of almond oil designated as sweet-almond oil, the importation[f] during the year ended June 30, 1906, amounted to 155,661 pounds. No record of the importation of apricot or peach kernel oil is available, but this in all probability aggregates much more than that of almonds, since the almond oil is chiefly consumed in pharmaceutical channels. It may be entirely possible that the above statistics also include some apricot and peach kernel oil.

THE VOLATILE OIL.

Previous statements have been made to the effect that the volatile oil from peach, apricot, and prune kernels does not exist as such in the kernel, but is dependent for its formation upon two important constituents, namely, the glucosid amygdalin and the ferment emulsin. When these two substances are brought to react in the presence of water, the volatile oil (benzaldehyde and hydrocyanic acid) and dextrose are produced. The amount of volatile oil capable of being

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[a] Allen, W. E., and Brewis, E. T. Trans. Brit. Pharm. Conf., p. 359. 1900.

[b] Rept., Schimmel & Co., April, 1893, p. 8.

[c] Hobein, M. Pharm. Post, p. 787. 1892.

[d] Rept., Schimmel & Co., October, 1894, p. 6.

[e] Oil, Paint, and Drug Reporter, vol. 73, No. 5, p. 32.

[f] Commerce and Navigation of the United States, p. 288. 1906.

formed is dependent in a measure on the amount of amygdalin present in a given quantity of kernels. It is therefore of interest to compare the relative yields of amygdalin from peach, apricot, and prune kernels with the yield from bitter almonds. Bitter almonds, as previously stated, contain 1 to 3 per cent of amygdalin.[a] By complete extraction of peach kernels with hot absolute alcohol a yield of 3 per cent of crystalline amygdalin was obtained; of apricot kernels, 2 per cent, and of prune kernels, 1.5 per cent. The amount of emulsin present does not affect directly the yield of volatile oil, inasmuch as it requires but one part of emulsin to hydrolyse about twelve parts of amygdalin.

As early as 1875 [b] bitter-almond oil was known to have been manufactured from peach kernels. At the present time the principal raw materials which serve for the manufacture of this oil are peach and apricot kernels,[c] and it is further stated that the article suffers very much from the scarcity of raw material during some seasons.[d]

The distillation of the oil from bitter almonds has fallen off greatly, and in fact has been practically discontinued, the oil being at present derived from apricot and peach kernels. This assumption is substantiated since the United States Pharmacopœia,[e] the National Dispensatory,[f] and the United States Dispensatory[g] describe the oil as "the volatile oil distilled from bitter almonds and other seeds containing amygdalin," the peach and apricot kernels falling in the category of "other seeds containing amygdalin."

METHODS OF EXTRACTION AND YIELD OF VOLATILE OIL FROM THE PRESS CAKE.

The extraction of the volatile oil from the press cake which remains after expressing the fixed oil from the seeds depends upon a process of maceration and subsequent distillation. The proper maceration of the press cake with water is an important essential for acquiring a maximum yield of oil, since the oil is formed by a process of fermentation. Much credence is generally given to the supposition that since emulsin is prone to decomposition at high temperatures the reaction should be completed before distillation is begun. The exact time for the reaction to complete itself has been a subject of some

[a] National Dispensatory, pp. 163–164. 1905.

[b] Proc. Amer. Pharm. Assoc., vol. 23, p. 504. 1875.

[c] Rept., Schimmel & Co., October, 1905, p. 5; National Dispensatory, p. 1054, 1905; Gildemeister, Hoffmann, and Kremers, The Volatile Oils, pp. 437–438.

[d] Rept., Schimmel & Co., October, 1907, p. 11; ibid., April, 1887, p. 20; ibid., April–May, 1906, p. 8.

[e] United States Pharmacopœia, eighth revision, p. 306.

[f] National Dispensatory, p. 1054. 1905.

[g] United States Dispensatory, 19th ed., p. 829.

comment, Pettenkofer[a] stating that forty-eight hours of maceration are required for the greatest yield of oil. Later Pettenkofer proposed a new method of maceration and distillation in which twelve hours[b] was given as the time of maceration.

The question of maceration no doubt is one of prime importance, and accordingly several alterations were applied in the laboratory with a view to determining the most practicable method as well as the one yielding the greatest quantity of oil.

The method promulgated by Pettenkofer as being most productive was applied in each case and consists in substance as follows: Of ground seeds 12 parts are added to from 100 to 120 parts of boiling water, and the mixture is kept at this temperature for fifteen to thirty minutes and then cooled. To the cooled mixture 1 part of fresh seeds mixed with 6 to 7 parts of cold water is added and the whole is allowed to macerate for twelve hours. The hot treatment extracts the amygdalin and the addition of fresh seeds supplies sufficient emulsin to hydrolyse the amygdalin. The results are as follows:

TABLE IV.—*Yield of volatile oil obtained from various fruit kernels.*

Quantity and kind of kernels distilled.	Quantity of luke-warm water added.	Period of maceration.	Yield of oil.	Yield from whole seed.	Yield calculated from press cake.	Yield obtained according to Pettenkofer, calculated from press cake.
Grams.	*Cubic centimeters.*	*Hr. min.*	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*
600 (peach)	2,000	1 30	4.2	0.7	1.17	1.26
1,000 (apricot)	2,000	0 30	16.0	1.6	2.6	1.8
1,000 (apricot)[a]	2,000	0 30	8.0	0.8	1.33	....
1,000 (prune)	1,500	0 30	3.0	0.3	0.47	....
650 (prune)	2,000	1 00	3.0	0.46	0.71	0.61
700 (bitter almond)	2,000	1 00	5.7	0.81	1.15	....

[a] Aqueous distillate cohobated but twice.

The results obtained seem to indicate that the time of maceration bears little relationship to the actual yield of oil, and apparently the reaction is completed in as short a time as a half hour, since the yield of oil obtained by maceration from a half hour to one and one-half hours is in most cases greater than a maceration of twelve hours.

Mention must also be made here of the separation of the oil from the distillate. The oil, being rather soluble in water (1 part in 300 parts), does not permit of a complete separation unless the distillate is subjected to a process of cohobation (i. e., redistillation of the aqueous distillate by direct application of heat, distilling over one-third to one-half of the solution, which in turn is subjected to the

[a] Pettenkofer. Jour. de Pharm. et Chim., 1862, p. 432.
[b] Pettenkofer. Liebig's Annalen, vol. 122, p. 81.

same process). In all of the distillations the results of which are presented in Table IV the aqueous distillate was cohobated four times and the oil separated and weighed. Owing to the ease of error in these distillations and in the separation of such small quantities of oil, the percentages given do not express absolute but only approximate yields. However, the percentages are rather too low than too high, since a distillation on a large scale would correspondingly diminish the experimental error entering into both distillation and separation.

By careful observation of the results of the distillations, the yields of oils appear to be equal to and in some cases considerably greater than the usual yield of oil from bitter almonds. The yield of oil from bitter almonds varies from 0.5 to 0.7 per cent,[a] but according to Whipple[b] a yield of 1.35 per cent was obtained from the ground cake.

The amount of oil obtained from apricot kernels was exceedingly high, 2.6 per cent of oil being obtained after complete cohobation of the distillate. A second distillation of apricot kernels indicated a yield of 1.33 per cent, which was much lower, owing to the fact that cohobation was resorted to but twice in order to ascertain whether the composition of the oil was affected in any way by several cohobations.

Peach kernels yielded 1.17 per cent of volatile oil (calculated from press cake), while prune kernels showed a much lower percentage, 0.71 per cent being obtained. This in part is accounted for by the lower content of amygdalin in the seeds and also by the possible effect of the heat employed during the pitting process upon the emulsin, which is destroyed or rendered less active by heat.

It is self-evident that twelve-hour macerations are not conducive to higher yields of oils, as was generally held. The process was less expeditious and in most cases less productive. The low production of oil by long maceration may be explained by the possible oxidation to benzoic acid of the benzaldehyde which is formed in the reaction and which constitutes the major part of the oil.

The most expeditious as well as the most productive method for securing volatile oil from these kernels, to be recommended because of its simplicity and ease of operation, is as follows: One part of ground kernels (or press cake) is mixed with 2 to 3 parts of lukewarm water and allowed to macerate or react with frequent agitation for a period of about one hour, after which steam under slight pressure is passed into the mixture and distillation is conducted until approximately four parts of distillate are obtained. After separation of the nonsoluble oil from the distillate, provided a complete yield of oil is desirable,

[a] Gildemeister, Hoffmann, and Kremers. The Volatile Oils, p. 437.
[b] Whipple. Pharm. Jour., vol. 10, p. 297.

the distillate is subjected to the process of cohobation three or four times in order to recover the oil which is in solution.

In this manner an exceedingly high yield of volatile oil is obtained, whereas if the distillate were not redistilled only approximately one-half or two-thirds of the oil would separate from the aqueous solution.

PHYSICAL AND CHEMICAL EXAMINATION.

Inasmuch as it is generally stated that the volatile oils from the peach and apricot are identical in every way with the oil from bitter almonds, the work of examination and comparison was undertaken to test this claim.

Since the United States Pharmacopœia,[a] in which the "oil from bitter almonds and other seeds containing amygdalin" is official, specifies certain physical and chemical properties, the analyses were taken up along these lines.

Chemically considered, the value of the oil is based upon the percentage of benzaldehyde and hydrocyanic acid which it contains.

Parallel to the physical and chemical analyses of the kernel oils, the analyses of bitter-almond oil freshly distilled from the bitter almonds and also of a market sample of the oil were jointly carried on for purposes of comparison. The results are shown in Table V.

TABLE V.—*Analyses of oils obtained from various fruit kernels.*

Number.	Kind of volatile oil.	Color.	Odor.	Taste.	Soluble in—	Specific gravity at 25° C.	HCn. (a)	Benzaldehyde (b)
							P. ct.	*P. ct.*
1	Peach	Faint straw.	Bitter almond-like; somewhat irritating.	Sweet and pungent.	Alcohol and ether, equal volumes (70 per cent alcohol).	1.068	2.20	73.1
2	Apricot	Light yellow	Aromatic; almond-like.	Sweet; intensely pungent.	do	1.062	2.40	[c] 61.8
3	Do	Straw color.	do	do	do	1.080	2.05	[d] 88.7
4	Prune	Faint straw.	Strong benzaldehyde.	Sweet and pungent.	do	1.050	1.75	76.0
5	Bitter almond	do	Less aromatic; fainter than above oils.	Sweet; less pungent.	do	1.056	4.80	62.0
6	Bitter almond (imported).[e]	Golden yellow.	Not agreeable; strongly almond-like.	Sweet; very pungent and biting.	do	1.057	2.80	63.9

[a] Assayed for hydrocyanic acid by the volumetric method (United States Pharmacopœia, eighth revision, p. 306).
[b] Assayed for benzaldehyde by the sodium sulphite volumetric method (United States Pharmacopœia, eighth revision, p. 306).
[c] Assayed after standing six weeks.
[d] Same as No. 2, assayed immediately after distillation.
[e] Purchased as United States Pharmacopœia bitter-almond oil.

The physical properties of the kernel oils suggest but very little difference between the sample extracted for experimental purposes and the sample of bitter-almond oil purchased on the market. As far

[a] United States Pharmacopœia, eighth revision, p. 306.

as color, odor, taste, and solubility are concerned the oils are practically identical, these properties being, however, of only comparative value. The specific gravities show differences which can hardly be construed to denote radical internal variation. The specific gravities of the peach and apricot oils fall very slightly outside of the limits prescribed by the United States Pharmacopœia, eighth revision, for oil of bitter almonds, but the other properties correspond strikingly.

The pharmacopœial requirement chemically is not less than 2 nor more than 4 per cent of hydrocyanic acid and not less than 85 per cent of benzaldehyde.

The hydrocyanic acid content of all the oils distilled and examined in the laboratory falls within the limits prescribed except the oil from prune kernels, which is 0.25 per cent below the lower limit, and the oil distilled from bitter almonds, which is 0.8 per cent above the higher limit.

The oil from apricot kernels (No. 3) is the only oil which reaches the requirement for benzaldehyde, showing by assay 88 per cent, the oil being assayed immediately after distillation. All the remaining oils, including genuine bitter-almond oil and oil purchased on the market, fall below the requirement for benzaldehyde content by several points, the prune and peach oils coming nearest to the requirement.

The prevalent low percentages of benzaldehyde may be accounted for by considering the susceptibility to oxidation which benzaldehyde possesses. Unless oils containing this constituent are kept in vessels that are completely filled and tightly stoppered, and are well protected from the light, oxidation of the benzaldehyde takes place very rapidly, benzoic acid being formed. Decomposition is also facilitated by the presence of water in the oil.[a] Oil free from water is said to possess better keeping qualities. Alcohol[b] also aids preservation if about 10 per cent is added to the oils. As much as 20.7 per cent of benzoic acid is said to have been formed in twelve hours. Samples of the oil have even been known to become a solid mass of crystals[c] (benzoic acid) in a few months.

Admitting this noticeable ease of oxidation, it is not surprising that the benzaldehyde content of the majority of oils examined was low. As all (with the exception of No. 2) were examined almost immediately after distillation, the low and variable content of benzaldehyde may be attributed to the fact that only small quantities of oils were dealt with and the numerous cohobations promoted ease and rapidity of oxidation by exposure of the oil to the oxygen of the air. Sample No. 2, possessing the lowest percentage of benzaldehyde, was kept in a

[a] Tilden, W. A. Hager's Centralhalle, p. 49. 1869.
[b] Proc. Amer. Pharm. Assoc., vol. 43, p. 1027. 1895.
[c] Lücker, Ed. Apoth. Ztg., vol. 20, p. 1044. 1905.

bottle not completely filled, which stood for a period of six weeks before assay.

Nothing is known of the precautions against deterioration taken in the case of sample No. 6, an oil purchased on the market, the low benzaldehyde content unquestionably indicating poor preservation.

A careful survey of the physical and chemical examination of these oils only serves to confirm the statements made that the oils from the several kernels are practically identical in composition, no discriminating characteristics being revealed.

COMMERCIAL USES AND VALUE.

Aside from the medicinal uses of the oil of bitter almonds and other kernel oils, which are valued chiefly for their sedative action produced by the hydrocyanic acid, they find a very extensive application in the perfume industry and for confectioners' purposes. In the latter instance an oil free from hydrocyanic acid must be used. Possibly the greatest part of the oil on the market at present does not enter pharmaceutical channels but is consumed by the confectioner and perfumery maker.

Although the so-called synthetic bitter-almond oil, or benzaldehyde, has done much to reduce the use and to disparage the value of this oil, there still remains considerable demand, both domestic and foreign, for the genuine article, which possesses certain points of value which the synthetic compound does not furnish.

The total importation of bitter-almond oil, or oil purchased under this name, during the year ended June 30, 1906, was 13,487 pounds.[a] The current wholesale price of the oil is from $3.25 to $4.75 per pound,[b] the prices fluctuating with the supply and demand.

Since the manufacture of the oil of bitter almonds from bitter almonds is now carried on only to a limited extent in foreign countries and the imported oil is in a great measure represented by oils made from peach, apricot, and prune kernels, attention may well be directed toward the vast amount of raw materials in the United States from which the oil can be produced.

QUANTITY AND DISPOSAL OF KERNELS.

APRICOT KERNELS.

The commercial production of apricots in the United States is confined chiefly to the State of California. It is estimated by growers that in a normal year there are grown and marketed sufficient apricots to produce as a by-product during the canning and drying operations about 5,000 tons of pits. The ratio by calculation which the kernel

[a] Commerce and Navigation of the United States, p. 988, 1906.

[b] Oil, Paint, and Drug Reporter, vol. 73, No. 5, p. 32.

bears to the pit in the case of apricots is about 20 to 25 per cent. This would mean the production of about 1,000 to 1,250 tons of apricot kernels during a single year.

At the present time the apricot pits are cracked by machinery at an expense of about 1½ cents a pound. The kernels are largely exported to Europe, and especially to Germany, where they are used for various purposes, principally, however, according to reports noted, for the manufacture of the fixed and volatile oils. Only a portion of the yearly output of kernels from California is consumed in the United States, and that probably only for confectioners' purposes.

From the figures presented it is estimated that there is a possible production of from 400 to 500 tons of fixed oil (by expression with hydraulic presses from 350 to 400 tons). From the press cake thus obtained, assuming a yield of 1.5 per cent of volatile oil (which is considerably below the actual yield), about 18,000 to 22,000 pounds of volatile oil could be distilled.

The majority of the kernels produced are exported, with a range of prices during the past six or eight years of from 5 to 12 cents per pound (varying with the crops), and subsequently, to a great extent, imported again by the United States in the form of the volatile and fixed oils produced therefrom.

PEACH KERNELS.

Peaches are produced much more generally in the United States than apricots, although in the California fruit regions much larger quantities of the stones are accumulated at canneries and drying grounds than elsewhere. A rough estimate of the quantity of peach pits obtained as a by-product from the peach industry in California alone during a normal year is 10,000 tons. The ratio of the kernel to the pit in this instance is much less than in the case of apricots, probably varying from 6 to 12 per cent; the California crop should therefore net from 600 to 1,200 tons of peach kernels a year.

The amount of fixed oil obtainable from these kernels by expression is approximately 210 to 420 tons. The amount of volatile oil from the press cake, calculated from a yield of 1 per cent, would be from about 7,800 to 15,600 pounds.

At the present time peach pits are not cracked nor the kernels exported to any great extent. Allowing a small quantity for use by nurseries, the remainder is chiefly used as a fuel, commanding from $5 to $7 a ton for this purpose. A more economical disposal of these kernels, so rich in fixed and volatile oils, might well be made in the United States by the growers and producers.

PRUNE KERNELS.

The pitting of prunes is not carried on to such an extent as is the case with peaches and apricots, this treatment being a relatively new feature. For this reason no figures are available. Attention is nevertheless directed to the large amounts of fixed oil and volatile oil which may be produced from these kernels, as well as from those of apricots and peaches, should they be utilized for this purpose.

SUMMARY.

(1) From the standpoint of relative composition, both the fixed and the volatile oils which can be produced from kernels of peaches, apricots, and prunes compare very favorably, and in some cases are almost identical, with the oils on the market obtained from the kernels of sweet and bitter almonds. The physical and chemical properties correspond in a striking degree to those of the almond oils and point to an extremely close relationship.

(2) In view of the fact that the oils from peach, apricot, and prune kernels are at the present time substituted for the rarer almond oils and have largely replaced them, the production of these oils in the United States suggests itself. Large quantities of kernels, especially of the apricot, are exported annually from the United States at low prices to foreign countries and the products manufactured from them are returned to this country. Peach stones containing kernels are largely burned as fuel. The possibility of a domestic production of these articles of commerce is therefore strongly emphasized by the ready availability of the raw materials.

(3) The adulteration or synthetic production of almond oils is not necessary and should be discouraged. The fixed oils from peach, apricot, and prune kernels can be and are used for the same purposes as almond oils; and such use ought not to be unjustifiable when their similarity of composition is considered. The volatile oils of these fruit kernels are practically identical with the oil of bitter almonds and could therefore entirely replace that oil in commerce, the cheapness of the kernels as compared with bitter almonds making them a more desirable and economical raw material.

(4) The extent of production, taking into account the cheapness and abundance of the raw material, might sufficiently reduce the prices of the fixed oils to render possible a broader and more extensive use than they enjoy at present. Owing to the ready saponification of these oils, a demand in the toilet-soap industry should be forthcoming. Foreign manufacturers are unable at times to supply the demand for almond oil, depending to a certain extent on the supply of the raw material—peach and apricot kernels—from America.

(5) The processes of extraction and distillation of fruit-kernel oils are not particularly complex and are such that the expense of maintaining and operating in establishments or canneries which are already equipped with steam or other power would be comparatively small.

(6) Attention may also be called to the value of the press cake or kernels from which the fixed and volatile oils have been extracted. Important economic use might be made of these extracted kernels as stock foods or as fertilizers, owing to their high content of nitrogenous matter.

(7) Careful consideration by the fruit growers of the United States should be given to peach, apricot, and prune kernels as waste products, with a view to their utilization in the production of important commercial articles heretofore almost entirely imported and representing no small economic value.

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U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 134
B. T. GALLOWAY, *Chief of Bureau.*

THE INFLUENCE OF A MIXTURE OF SOLUBLE SALTS, PRINCIPALLY SODIUM CHLORID, UPON THE LEAF STRUCTURE AND TRANSPIRATION OF WHEAT, OATS, AND BARLEY.

BY

L. L. HARTER, Assistant Physiologist.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 27, 1908.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 134 of the series of this Bureau the accompanying technical paper entitled "The Influence of a Mixture of Soluble Salts, Principally Sodium Chlorid, upon the Leaf Structure and Transpiration of Wheat, Oats, and Barley," by Mr. L. L. Harter. This paper has been submitted with a view to publication by Mr. T. H. Kearney, Physiologist in Charge of Alkali and Drought Resistant Plant Breeding Investigations.

The investigations here described help to explain the physiological effects of alkali salts upon plants and hence to throw light upon the problem of what constitutes alkali resistance. The solution of this problem is of great importance in connection with the work of securing useful crop plants for growing in alkali soils.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE INFLUENCE OF A MIXTURE OF SOLUBLE SALTS, PRINCIPALLY SODIUM CHLORID, UPON THE LEAF STRUCTURE AND TRANSPIRATION OF WHEAT, OATS, AND BARLEY.

INTRODUCTION.

The investigation reported upon in the following pages was undertaken with a view to ascertaining whether the presence of a mixture of soluble salts, consisting chiefly of sodium chlorid, such as occurs in excessive quantities in many natural "alkali" soils, will affect the structure of plants not especially adapted to such soils, and if modifications of structure take place whether they resemble those which characterize plants growing naturally in saline soils (halophytic plants). The effect of this salt upon the transpiration of nonhalophytic plants was also studied.

It has been possible to demonstrate that culture in a soil containing considerable quantities of sodium chlorid together with other salts produces measurable changes in the leaf structure of wheat, oats, and barley and that these changes are in the direction of xerophytic and halophytic structure, i. e., that which characterizes plants that naturally inhabit very dry situations or saline soils. The most noticeable modification thus produced was the conspicuous bloom or waxy deposit that formed on the surface of the leaves. In control plants grown in nonsaline soil the bloom was so little developed as to be hardly observable. This development of bloom was accompanied by an easily measurable increase in the thickness of the cuticle and outer walls of the epidermal cells and by a marked decrease in their size.

In regard to transpiration, it was found that when the "alkali" salts are present in sufficient concentration to cause the modifications of structure above noted transpiration is considerably reduced. On the other hand, the same salts when present in amounts too small to produce any measurable influence upon structure have a decidedly stimulating effect upon transpiration.

It is believed that this line of investigation will throw much light upon the problem of what constitutes "alkali resistance" and will therefore be of service in the search for useful plants adapted to growing in saline or "alkali" soils.

EFFECT OF A MIXTURE OF SOLUBLE SALTS, PRINCIPALLY SODIUM CHLORID, ON PLANT STRUCTURE.

METHODS OF EXPERIMENTS.

Experiments to determine the influence of a mixture of salts in modifying the structure of plants were undertaken with wheat (*Triticum durum*), oats (*Avena sativa*), and barley (*Hordeum distichum*). The plants were grown in a greenhouse where the conditions as to light, heat, and moisture were fairly uniform. The seeds were germinated and the seedlings were grown for about four weeks in the soils with which the experiments were made.

The saline soil used was obtained from the vicinity of Salt Lake City, Utah,[a] and while it contained some sodium sulphate, sodium bicarbonate, and potassium sulphate, the results obtained are probably to be attributed chiefly to the action of sodium chlorid, since this is by far the most abundant salt present.

By mixing the saline soil with the requisite quantity of garden loam (from Washington, D. C.), the different concentrations of total soluble salts with which experiments were made (2 per cent, 1.5 per cent, and 1 per cent of the weight of the dry soil) were obtained, the percentages being calculated from the electrolytic resistance of the saturated soil.

On the basis of the analysis by the Bureau of Soils these three concentrations of total soluble salts would represent, respectively, 1.4, 1, and 0.7 per cent of sodium chlorid. These percentages are considerably above the limit which under natural field conditions is generally considered safe for wheat, oats, and barley. In fact, 0.5 per cent of sodium chlorid will usually prevent the production of seed in these plants.

In every case a check planting was made in the garden loam to serve as a control on the plants growing in the saline soil.

In order to prevent the leaching out of the salt in watering, the plants were grown in glass pots. These had a capacity of about 800 grams of the soil used. By careful watering, the salt was kept well distributed through the soil in the pot until the seeds had germinated and the plants had developed two or three leaves.

The effect of the salts on the structure of the plant was determined by sectioning the leaf and measuring the thickness of the cuticle and the size of the epidermal cells. All sections were made near the mid-

[a] An analysis by the Bureau of Soils, U. S. Department of Agriculture, of a sample of soil used in these experiments before mixing it with garden loam showed that it contained 2.1 per cent of soluble salts, of which 4.66 per cent was potassium sulphate, 16.98 per cent sodium sulphate, 70.58 per cent sodium chlorid, and 7.78 per cent sodium bicarbonate.

dle of the third leaf when the fourth leaf was about one-fifth the length of the leaf sectioned. Measurements were made of the thickness of the cuticle and outer wall (taken together) and also of the length and height of the cells of all epidermal cells in a transverse section between the third vein (counting the midrib as one) and the fourth vein on both the upper and the lower surfaces of the leaf. The filar micrometer was used in making the measurements.

The outer walls of the epidermal cells were measured together with the cuticle because in these young plants the latter is so thin that accurate measurements of the cuticle alone could not be made without the expenditure of a great amount of time. Careful preliminary measurements, however, were made of both the cuticle and the outer epidermal cell wall independently, the cuticle and cell wall being differentiated by staining with chloriodid of zinc. As a result it was found that the thickening had taken place chiefly in the cuticle and not in the cellulose zone of the cell wall. In the case of each plant species grown in each of the soils containing different concentrations of soluble salts as well as in the control soil, about 100 measurements of the cuticle and outer wall of the epidermal cells were made on both the upper and the lower leaf surfaces. Averages of the whole number of measurements are given in Table I.

In a similar manner measurements were made of the length and the height of the epidermal cells on both the upper and the lower leaf surfaces of each plant species grown in the soils containing different concentrations of soluble salts and in the controls. (Tables II and III.)

RESULTS OF EXPERIMENTS.

EFFECT ON THE FORMATION OF BLOOM.

The growth of the plants was retarded by the amount of soluble salts present. Wheat and oats made a slow growth in the soil containing 2 per cent of total salts (1.4 per cent sodium chlorid) and barley failed to germinate at this concentration. Seedlings of all three species grown in the soil containing 1.5 per cent of total salts (1 per cent of sodium chlorid) made a better growth, but were very weak. Seedlings grown in a soil containing 1 per cent total salts (0.7 per cent sodium chlorid) did fairly well, but were still decidedly inferior to the controls. Under natural conditions many agricultural plants, especially cereals, are unable to endure a soil content of more than 1 per cent of sodium chlorid, and even a considerably less amount will usually produce imperfect development.

Soon after the plants in the saline soils appeared above the surface of the soil they took on a dark bluish-green color, evidently due to

the presence of a coating of wax on the leaves,[a] while the control plants in every case retained their normal green color.

A comparison under the microscope of sections of leaves from plants grown in the saline soils with those of the controls showed that the waxy deposit on the cuticle was strongly developed in the former, but almost completely wanting in the latter. Bloom did appear, however, to some extent on the leaves of the control plants after the ground was allowed to become dry, indicating that the formation of bloom can be stimulated by a lack of water in the soil as well as by the presence of an excess of soluble salts.

The bloom was present in equal amount on both the upper and the lower surface of the leaf.[b] It appeared as a thin, almost homogeneous layer of waxlike substance which showed a slight tendency to accumulate along the lines of junction of the outer with the radial walls of the epidermal cells. A careful examination of the areas over the stomata[c] showed that there was no greater accumulation of bloom there than on any other portion of the leaf, the deposit of wax on the outer walls of the guard cells and the cells adjoining them being of uniform thickness with that overlying other cells.[d]

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[a] As to the origin of the bloom or wax on the leaves and stems of plants there are many theories, some of which were advanced as early as 1827. De Candolle asserted that the wax appears on the surface in the form of a liquid and is coagulated upon exposure to the air.

Karsten (Vegetationsorgane der Palmen) and Uloth (Ueber die Wachsbildung in Pflanzenreich, Flora, 1867, p. 422) sought to show that bloom originated through a complete chemical change of the cuticle and other cell wall layers. De Bary, on the other hand, contended that the bloom could not be the product of a modification of the cell wall, but that the wax is secreted by the epidermal cells themselves.

[b] Francis Darwin (On the Relation Between the "Bloom" on the Leaves and the Distribution of the Stomata. Journ. Linn. Soc. Bot., 22 : 99, 1886) found from a study of different species of Trifolium that there is a close relation between the distribution of the bloom and that of the stomata. When the bloom is on the upper surface of the leaf only, the average number of stomata on that surface (as compared with the lower) is twice as great as where both surfaces are covered with bloom.

[c] Wulff (Studien über verstopfte Spaltöffnungen, Oesterr. Bot. Ztschr., 48 : 201, 252, 298, 1898) made a study of the bloom on a large number of plants widely separated in relationship and found the stomata in many cases covered with wax. He states that while transpiration is largely reduced by means of the wax or bloom covering the stomata, assimilation still continues, and mentions in this connection Drimys, Elymus, *Papaver nudicaule*, and other plants.

Schleiden (Harmlose Bemerkungen über die Natur der Spaltöffnungen, Naturgesch., J. 4, bd. 1, pp. 56–59, 1838) noticed that the stomata of some species of the conifers were covered over with a wax, but does not mention Link, who observed the same condition earlier.

[d] De Bary (Ueber Wachsüberzüge der Epidermis, Bot. Ztg., J. 29, No. 9, p. 128; No. 10, p. 144; No. 11, p. 160, 1871) has made what is perhaps the most extensive study of the deposition of wax on the stem and leaves of plants that has ever been carried out. His observations include a large number of different species, as, for example, *Klopstockia cerifera*, *Panicum turgidum*, *Copernica cerifera*, and *Heliconia farinosa*. He found the wax to be in many cases more abundant on the guard cells and the cells adjoining them than on other portions of the leaf surface.

In view of the fact that Francis Darwin found the bloom in different species of *Trifolium* to be most strongly developed on the leaf surface having the greatest number of stomata, a count was made of the stomata on equal areas of both surfaces of the leaves of wheat, oats, and barley. In these cases the number of stomata as well as the amount of bloom was found to be about the same on both surfaces of the leaves.

EFFECT ON THE THICKNESS OF THE CUTICLE.

The following table shows the average thickness of the cuticle[a] and outer epidermal cell wall (taken together) of the upper and lower surface of the leaf of each of the different plant species grown in the soils containing various concentrations of soluble salts and in the control soils, the results of the measurements being expressed in microns.

TABLE I.—*Thickness of the cuticle and outer epidermal cell wall (taken together) of three species of plants grown in soils containing different concentrations of readily soluble salts.**

Plant.	Control (nonsaline soil).		Soil containing 1 per cent total salts (estimated 0.7 per cent sodium chlorid).		Soil containing 1.5 per cent total salts (estimated 1 per cent sodium chlorid).		Soil containing 2 per cent total salts (estimated 1.4 per cent sodium chlorid).	
	μ	μ	μ	μ	μ	μ	μ	μ
Wheat (*Triticum durum*)	2.6	2.7	3.2	3.0	3.2	3.2	3.3	3.3
Oats (*Avena sativa*)	2.4	2.2	3.0	3.0	3.2	3.3	3.2	3.2
Barley (*Hordeum distichum*)	2.5	2.4	3.0	3.0	3.2	3.3	....	....

*The figures represent in each case averages of about 100 measurements.

It will be seen from the above table that the thickness of the cuticle increases with the concentration of salt in the soil. In every case the thickness of the cuticle on both surfaces of the leaves is greater in plants grown in the soil containing an excess of soluble salts than in the control plants, and increases with the concentration of the total soluble salts present. The single exception to the latter rule was the lower leaf surface of the leaf of oats (*Avena sativa*) grown in soil containing 1.5 per cent of total salts, the average thickness of the cuticle having been in this case slightly greater than in the soil containing 2 per cent of total salts; but the difference is unimportant and is within the limits of experimental error.

In wheat, oats, and barley, so far as these experiments show, there seems to be little difference in the thickness of the cuticle between the upper and lower surfaces of the leaves, whether in soils containing an excess of readily soluble salts or in the nonsaline soils.

[a] All measurements of the thickness of the cuticle were made exclusive of the waxy deposit, which had been previously dissolved off by the addition of xylol.

EFFECT ON THE SIZE OF THE EPIDERMAL CELLS.

Table II gives the results of measurements, expressed in microns, of the average length and height of the epidermal cells of the upper leaf surface of three species of plants grown in soils containing different concentrations of soluble salts and of control plants grown in nonsaline soils.

TABLE II.—*Dimensions of epidermal cells of the upper leaf surface of different plant species grown in soils containing various concentrations of soluble salts.*[a]

Plant.	Control (non-saline soil).		Soil containing 1 per cent total salts (estimated 0.7 per cent sodium chlorid).		Soil containing 1.5 per cent total salts (estimated 1 per cent sodium chlorid).		Soil containing 2 per cent total salts (estimated 1.4 per cent sodium chlorid).	
	Length.	Height.	Length.	Height.	Length.	Height.	Length.	Height.
	μ	μ	μ	μ	μ	μ	μ	μ
Wheat (*Triticum durum*)	50.5	50.9	29.8	26.0	40.3	34.1	29.4	26.0
Oats (*Avena sativa*)	41.9	33.2	34.3	30.6	31.4	29.5	36.8	27.5
Barley (*Hordeum distichum*)	44.6	37.2	37.5	34.3	30.8	36.3	....	....
Average	45.7	40.4	33.9	30.3	34.2	33.3	33.0	26.8

[a] The figures represent in each case averages of about 100 measurements.

Table III gives the results of measurements expressed in microns of the average length and height of epidermal cells of the lower leaf surface of three species of plants grown in soils containing different concentrations of soluble salts and of control plants grown in non-saline soil.

TABLE III.—*Dimensions of epidermal cells of the lower leaf surface of different plant species grown in soils containing various concentrations of soluble salts.*[a]

Plant.	Control (non-saline soil).		Soil containing 1 per cent total salts (estimated 0.7 per cent sodium chlorid).		Soil containing 1.5 per cent total salts (estimated 1 per cent sodium chlorid).		Soil containing 2 per cent total salts (estimated 1.4 per cent sodium chlorid).	
	Length.	Height.	Length.	Height.	Length.	Height.	Length.	Height.
	μ	μ	μ	μ	μ	μ	μ	μ
Wheat (*Triticum durum*)	47.4	48.4	31.9	33.2	34.9	32.3	30.8	24.1
Oats (*Avena sativa*)	45.0	37.2	32.3	33.3	30.4	30.6	27.9	25.4
Barley (*Hordeum distichum*)	44.2	44.9	36.2	37.1	36.5	42.2	....	....
Average	45.5	43.5	33.5	34.5	33.9	35.1	29.3	24.7

[a] The figures represent in each case averages of about 100 measurements.

It will be seen from Tables II and III that the leaves of the three plants grown in soils containing an excess of soluble salts have on an average smaller epidermal cells than those of the controls, the upper and lower leaf surfaces showing but little difference in this respect. Taking the average for all three species the length of the epidermal cells of the controls on both the upper and the lower surfaces of the leaf averages about 35 per cent greater than that of the epidermal

cells of the same plants grown in the soil containing 1 per cent total salts (estimated 0.7 per cent of sodium chlorid). The height (average for all three species) of the cells on the upper leaf surface of the control plants is about 33 per cent and that on the lower surface about 26 per cent greater than that of the plants grown in a soil containing 1 per cent of total salts.

A comparison of the height of the epidermal cells of plants grown in nonsaline soils and in soils containing 2 per cent of total salts (estimated 1.4 per cent of sodium chlorid) shows even more striking differences. The height of the epidermal cells on the upper leaf surfaces (average for all three species) is 51 per cent and on the lower surface 76 per cent greater in the control plants than in plants of the same species grown in a soil containing 2 per cent of total salts.

EFFECT OF A MIXTURE OF SOLUBLE SALTS, PRINCIPALLY SODIUM CHLORID, ON TRANSPIRATION.

EFFECT OF SALTS WHEN PRESENT IN SUFFICIENT QUANTITY TO PRODUCE BLOOM.

Wheat (*Triticum durum*) was germinated and grown in a natural saline soil containing 1.5 per cent of total soluble salts (estimated to contain 1 per cent of sodium chlorid), where the plants soon became covered with a copious bloom, and in a nonsaline soil as a control, where the bloom was inconspicuous. When the plants were about 6 inches high the leaves were detached and their cut surfaces were sealed by dipping in melted paraffin. They were then weighed at frequent intervals during a period of several hours, several leaves from the plants grown in saline soil being weighed together and several from the controls. All the leaves in each experiment were kept between weighings under uniform conditions as to heat, light, and moisture. The loss recorded at each weighing was taken as a measure of the amount of water transpired.

In the first experiment of this series the total initial weights of the leaves from plants grown in the saline soil and of those from the control plants were respectively 221 and 262 milligrams. After an exposure of twenty-one hours to the atmosphere of an ordinary room the weights were respectively 191 and 197 mg.; hence the leaves from plants grown in the saline soil lost 13.6 and those from the control plant 24.8 per cent of their original weights. An even greater difference was shown in a second experiment. In this the leaves from plants grown in the saline soil weighed at the beginning 377 mg. and the control 506 mg. The former lost 59 mg. and the latter 245 mg. in nineteen hours, or about 16 per cent and 48 per cent, respectively.

A third experiment in which the leaves were weighed at more frequent intervals gave results as follows, the weights being expressed in milligrams:

TABLE IV.—*Transpiration from leaves of plants grown in a saline and in a nonsaline soil as shown by the results of weighings at frequent intervals.*

Conditions of leaves and soil in which grown.	Weights at intervals of one-half to three-fourths hour.						
	12.45 p. m.	1.15 p. m.	1.45 p. m.	2.15 p. m.	2.45 p. m.	3.30 p. m.	4.15 p. m.
	mg.	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*	*mg.*
With bloom (grown in a soil containing 1.5 per cent of soluble salts)	281	276	272	272	270	268	267
Without bloom (control)	251	227	220	215	211	205	200

The leaves with bloom lost a total of 14 milligrams, or about 5 per cent of their original weight, while those without bloom lost 51 milligrams, or about 21 per cent of their original weight.

Whether the retardation of loss of water from the leaves of plants grown in soils containing considerable quantities of soluble salts when cut from the stems and exposed to the air is due to the presence of the bloom that develops on the leaf under these conditions or to the concentration of the cell sap, or to a combination of these factors, remains to be determined. The above-described results demonstrate, however, that leaves of wheat plants grown in saline soils containing as much as 1.5 per cent of salts lost considerably less moisture when cut off and allowed to dry than leaves of plants of the same species grown in a soil where no excess of salts was present but under similar conditions otherwise. Since in the former case, however, a relatively thick deposit of wax had developed upon the surface of the leaves, it is reasonable to assume that the presence of this bloom played some part in the decreased transpiration.[a]

[a] Sachs (Physiology of Plants) says: "The epidermis affords a protection against the excessive evaporation of the water from the leaves and young shoot-axes by means of the cuticle and the waxy coatings, which it is true do not absolutely prevent the evaporation of water from the epidermis cells, but render it exceedingly slow."

Reynolds (The Effect of Bloom on the Transpiration of Leaves, Bulletin No. 9, Oberlin College, 1898) found that the leaves of *Agave utahensis*, *A. verschafelti*, *A.* sp., *Echevera peacockii*, and *Cotyledon* sp. from which the bloom had been removed lost about one-third more water than the same plants from which the bloom had not been removed. The results of Reynolds agree with those of Fr. Haberlandt (Wissensch praktische Untersuchungen auf dem Gebiete des Pflanzenbaues, 3: 156, 1877), who claims to have proved that the bloom on rape leaves is formed as a check upon transpiration, and with Garreau (Ann. d. Sci. Nat., 13: 322, 1849), who says that the removal of any waxy covering the leaf may possess favors transpiration.

EFFECT OF SALTS WHEN PRESENT IN AMOUNTS TOO SMALL TO PRODUCE BLOOM.

Wheat (*Triticum durum*) was also used in the experiments to determine the effect upon transpiration of a mixture of soluble salts, chiefly sodium chlorid, when present in the soil in quantities too small to produce any perceptible modification in the structure of the plants. As in previous experiments the seed was germinated and the seedlings were grown in the soils tested.

All plants were grown either in paraffined wire baskets or in glass jars, so that there was in no case any possibility of loss of water through the bottom or sides of the vessels. Five plants were grown in each vessel. Just previous to weighing, the pots were sealed over by means of paraffined paper, thus reducing to a minimum the possibility of loss of water except through the surface of the leaf.

The water lost by transpiration was determined by weighing the pots with the plants in them, the weighings being made at intervals of four to eight hours during the day for a period of two or three days. After the final weighing the area of the leaf surface was determined by making impressions of the leaves on solio photographic paper. The photographic paper was then weighed. The area of the leaf surface was then cut from the photographic paper and the remaining portion weighed. From the weight of the original photographic paper which was found by measurement to contain a certain number of square centimeters and the loss of weight after cutting out the impression made by the leaves, the actual area of the leaf surface could readily be calculated. The amount of water lost by transpiration could therefore be expressed in milligrams per square centimeter of leaf surface per hour—the unit which will be used in the discussion that follows.

Two series of experiments were conducted with wheat in natural soils containing, respectively, 0.09 and 0.12 per cent of total salts and estimated to contain, respectively, 0.06 and 0.08 per cent of sodium chlorid. These concentrations were obtained by thoroughly mixing the requisite quantity of garden loam with alkali soil obtained near Salt Lake City, Utah, the percentage of water-soluble salts present in the soil as thus made up being determined by means of the electrolytic bridge. The controls were grown in the pure garden loam. An examination of the plants grown in the alkali soils showed that the bloom was very slightly developed, probably not to a sufficient

degree to produce any material influence on the loss of water through the leaf.

The following table gives the amount of water transpired by wheat plants in soils containing these two concentrations of alkali salts and by the controls in each case, the amount of water transpired being expressed in milligrams per square centimeter of leaf surface per hour:

TABLE V.—*Amount of water transpired by wheat plants grown in soils containing different concentrations of soluble salts and by control plants grown in nonsaline soils.*

Series of experiments.	Control.	Soil containing 0.09 per cent total salts (estimated 0.06 per cent sodium chlorid).	Control.	Soil containing 0.12 per cent total salts (estimated 0.08 per cent sodium chlorid).
	mg.	*mg.*	*mg.*	*mg.*
No. 1	2.16	4.21	2.35	2.80
No. 2	3.27	3.98	3.01	3.35

The results show that transpiration is stimulated by the presence of amounts of soluble salts too small to produce any perceptible modification of structure. The stimulation was greatest in the soil containing the smaller amount of alkali, the amount of water transpired by the plants in the 0.09 per cent soil having been in the two series of experiments, respectively, 94 per cent and 21 per cent greater than in the corresponding controls, while in the 0.12 per cent soil it was only 19 per cent and 11 per cent greater.

GENERAL SIGNIFICANCE OF RESULTS.

It is not improbable and in fact these experiments seem to demonstrate that plants that are not halophytes when grown in saline soils undergo modifications of structure of a kind that are believed to reduce transpiration. It is a well-known fact that most xerophytes—i. e., plants growing naturally in dry situations—differ in many points of structure from mesophytes and hydrophytes (plants whose natural habitats are, respectively, moderately moist and very wet situations). Some of these characteristics of xerophytic plants, such as the reduction of the number of stomata, the situation of the latter in pits or furrows, the development of a covering of hairs on the leaf surface, etc., are doubtless efficacious in diminishing transpiration. Other means of protecting against excessive loss of water are thickening of the cuticle and its reenforcement by the secretion of wax or bloom which is deposited on its surface. Most halophytes (plants growing naturally in saline or "alkali" soils) exhibit similar peculiarities of structure.

The increased thickness of the cuticle and of the deposit of wax on the leaves observed in the experiments described in these pages can safely be attributed to the influence of an excess of soluble salts in the soil, since the presence of these salts in different concentrations or their absence was the only variant introduced. Pfeffer[a] is of the opinion that as a rule the cuticle is more strongly developed when there is a scarcity of soil moisture. But even under extremely arid climatic conditions, soils containing a large amount of soluble salts are usually in a moist condition. It is generally believed, however, that an excess of soluble salts in the soil will check the absorbing activity of the roots, thus creating a condition of "physiological drought."

In all the experiments, the results of which are summarized in Tables I, II, and III, the plants in saline soils and the controls grown in nonsaline soils were given an equal amount of water, yet the plants grown in saline soils modified their structure by depositing bloom on the leaf surface, by thickening the cuticle, and by reducing the size of the epidermal cells.[b] It would seem then that the plants in saline soils, although furnished an amount of soil moisture that was sufficient to produce a normal growth in the nonsaline soil, were actually subjected to xerophytic conditions. The explanation appears to be that the roots of the plants in saline soils were unable to take up moisture as readily as those in nonsaline soils, and the plants were therefore forced to modify their structure in the manner above described in order to reduce their transpiration.

So far as the results of these experiments can be regarded as conclusive, it may be said that when wheat plants are grown in a soil containing 0.7 to 1.4 per cent of sodium chlorid in addition to other salts the plants begin almost immediately after germination to take on xerophytic characters.

An indirect influence of the salt on transpiration is also shown (see Table IV), since the leaves of wheat plants grown in a soil containing 1.5 per cent total salts (1 per cent of sodium chlorid) lost considerably less water than the leaves of plants grown in nonsaline soils.[c] The decrease of transpiration from leaves of plants grown in saline soils when compared with those of the controls may be attributed to two factors: (1) The deposit of wax or bloom on the

[a] Physiology of Plants (Ewart's Translation), I: 239.

[b] Kissel (Der Bau des Gramineenhalmes unter dem Einflus verschiedener Düngung. Inaug. Diss. Giessen, 1906. Review in Bot. Centralbl., 109:403, 1908) found that phosphoric acid caused a thickening of the cell walls, and a diminution of the cell cavities in the stems of grasses. On the other hand nitrogen and lime induced a contrary effect. Results with potash were inconclusive as regards oats, but in the case of other grasses the effects were similar to those of nitrogen and lime.

[c] These results are in accord with those of Reynolds previously referred to.

leaf surface and the accompanying thickening of the cuticle and (2) increased concentration of the cell sap.[a]

The increased transpiration observed in wheat plants grown in soils containing an amount of soluble salts too small to cause any increase in the thickness of the cuticle or bring about any measurable deposition of wax is probably to be regarded as a result of chemical stimulation. It is well known that stimulation is effected by dilute solutions of many substances which at greater concentrations are toxic to plants. The writer[b] found that magnesium chlorid, magnesium sulphate, sodium sulphate, and sodium bicarbonate in water cultures stimulated the growth of wheat seedlings when present in dilutions too great to be toxic. Burgerstein,[c] who has made a very extensive study of the transpiration of plants under various conditions, finds that maize plants when subjected to solutions of 0.02, 0.10, and 0.25 per cent potash (K_2O) and soda (Na_2O) for a period of from one to four days exhibited a decreased transpiration as compared with control plants growing in distilled water. On the other hand maize plants grown during a period of forty-three to one hundred hours in solutions of 0.1, 0.25, 0.5, and 1 per cent of calcium nitrate and magnesium sulphate showed an increase of transpiration in the two weaker concentrations but a decrease in the two stronger concentrations. Burgerstein further finds that in very dilute solutions (0.05 to 0.25 per cent) of magnesium, of ammonium sulphate, and of calcium carbonate, transpiration as compared with that in distilled water increases with the concentration of the solution until a maximum is reached.

SUMMARY.

(1) Plants of wheat, oats, and barley grown from seeds in soils containing 1, 1.5, and 2 per cent of total salts (0.7, 1.0, and 1.4 per cent of sodium chlorid) very soon develop a pronounced waxy bloom upon the leaf surface and a thickening of the cuticle.

(2) The thickness of the cuticle increases with the concentration of the soil solution.

(3) The size of the epidermal cells decreases as the concentration of the salt in the soil increases, the epidermal cells of the plants grown in nonsaline soils being on an average the largest and those in the soils containing the greatest concentration of salts being the smallest.

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[a] Sachs (Ueber den Einfluss der chemischen und physikalischen Beschaffenheit des Bodens auf die Transpiration der Pflanzen, Gessammelte Abhandlungen, 1: 417, 1892) states that transpiration from leaves may be reduced by the presence of materials dissolved in the water which the roots take up.

[b] The Variability of Wheat Varieties in Resistance to Toxic Salts, Bulletin 79, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1905, p. 42.

[c] Die Transpiration der Pflanzen, Eine Physiologische Monographie, 1904.

(4) When the amount of sodium chlorid present is much below the minimum concentration that is injurious under field conditions no perceptible modifications of the plant structure occur.

(5) Leaves of wheat detached from plants grown in nonsaline soil on which the bloom was not conspicuous lose by transpiration two to three times as much moisture in the same length of time as leaves from plants grown in a soil containing 1.5 per cent of total salts (about 1 per cent of sodium chlorid) and which possessed a marked development of bloom.

(6) Wheat plants grown in soils containing naturally 0.09 and 0.12 per cent of total salts (0.06 and 0.08 per cent of sodium chlorid) show an increased transpiration as compared with plants grown in a nonsaline soil. Of the two saline soils, that containing the smaller concentration of salts induced the heavier transpiration.

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 135.

B. T. GALLOWAY, *Chief of Bureau.*

ORCHARD FRUITS IN THE PIEDMONT AND BLUE RIDGE REGIONS OF VIRGINIA AND THE SOUTH ATLANTIC STATES.

BY

H. P. GOULD,

POMOLOGIST IN CHARGE OF FRUIT DISTRICT INVESTIGATIONS.

ISSUED DECEMBER 31, 1908.

WASHINGTON:

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., July 11, 1908.

SIR: I have the honor to transmit herewith a manuscript entitled "Orchard Fruits in the Piedmont and Blue Ridge Regions of Virginia and the South Atlantic States" and to recommend that it be published as Bulletin No. 135 of the series of this Bureau. This bulletin was prepared by Mr. H. P. Gould, Pomologist in Charge of Fruit District Investigations, and has been submitted by Mr. William A. Taylor, Pomologist in Charge of Field Investigations in Pomology, with a view to its publication.

The fruit-growing interests in these regions have attained considerable importance, though their pomological resources are comparatively undeveloped at the present time. This is especially the case in the mountain region where there exist extensive sections which are doubtless of greater value for fruit growing than for any other agricultural purpose.

The determination of the behavior of varieties of orchard fruits under definitely stated conditions as here set forth is believed to be of value in guiding the planting of varieties in the further development of the fruit-growing industry of these regions. New orchards are constantly being planted, and their success or failure is in a large degree dependent upon the selection of varieties adapted to the conditions under which they are to be grown and suitable for the purposes for which they are desired. In the Blue Ridge region, where conditions of orcharding are very variable, due to differences in elevation and soil, very careful discrimination is of special importance in selecting varieties for planting. While the information here supplied will doubtless prove of value to prospective planters of orchards who already reside in these regions, it is expected that its greatest usefulness will be to those who are unfamiliar with the conditions, but who may be attracted to these sections by the opportunities which they offer for fruit growing.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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ILLUSTRATIONS

ORCHARD FRUITS IN THE PIEDMONT AND BLUE RIDGE REGIONS OF VIRGINIA AND THE SOUTH ATLANTIC STATES.

INTRODUCTION.

In explanation of the nature and object of the fruit district investigations of the Bureau of Plant Industry, of which the present paper is the first published report, the following general outline of the work may assist the reader in his understanding of their relation to the fruit-growing interests of the country.

That varieties of fruit are not equally well adapted to all conditions of soil, climate, elevation, etc., under which they may be grown is apparent to every fruit grower and to others who are in the habit of observing the behavior of fruit and fruit trees. The geographical limit of the profitable commercial range of many of the more important varieties of fruits is comparatively well known, yet within such limits there are many instances which might be mentioned of sections that are noted for the unusually high degree of perfection to which some particular variety attains in one or more of its important characteristics. The degree of perfection reached may be in the general appearance of the fruit or in its size, form, color, texture, flavor, time of ripening, or keeping quality, or in the productiveness, vigor, and healthfulness of the tree, etc. On the other hand, another section within the accepted commercial range of a variety may have a reputation for producing fruit which is strikingly lacking in some desirable feature.

While the commercial aspect of these investigations is the more important one from a financial point of view, it is necessary, also, to consider them from the standpoint of the home supply. The object for which fruit is to be grown must be taken into account in considering the merits and behavior of a variety. A particular sort may have characteristics which render it of special value in some locality for a given purpose, but it may be entirely unsuited to some other use. A variety which in a particular location is too small or has a very tender skin, or the tree of which is relatively unproductive,

would obviously not be commercially satisfactory; yet it may possess high dessert quality which renders it desirable for home use where the basis of merit is not the market value of the product.

The influence of conditions such as soil and climate upon the behavior of varieties, and consequently upon their relative value for any particular purpose, indicates the importance, and even the necessity, of determining those conditions or combinations of conditions which best meet their individual requirements, if the planting of fruits is to be done with the greatest possible assurance of success. Many orchards and fruit plantations have been set out in the past which have been unprofitable because varieties were planted which were poorly adapted to the conditions under which they were grown; or, if not resulting in actual loss, they have been less profitable than would have been the case had varieties been selected which were better adapted to the conditions.

The ability of a variety to reach a high degree of perfection, however, does not alone determine its profitableness or desirability for any particular place. Adequate means must be at hand for transporting the product from the point where it is grown to the consumer. Because of insufficient means of transportation, the commercial growing of fruit is rendered impossible in many sections that are naturally well suited to certain kinds.

In the case of quickly perishable fruits, like peaches, the exact time of ripening is also frequently an essential factor. It is often this feature which determines very largely the profitableness of a variety. If a particular sort ripens a few days earlier or later than some other one, it may be just in time to fill a period in the market when the supply would otherwise be light, and hence it is desirable on this account. Similarly, another variety may be undesirable because its season of ripening comes at the same time as some other variety which has a better commercial rating.

The time of ripening has a still wider application in the case of some kinds of fruit of which the range in the ripening period of all varieties in general cultivation is comparatively short. For instance, the commercial growing of strawberries is rendered unprofitable in many sections because the "strawberry season" comes at the same time as in some other sections where the berries grow equally well and which are more favorably located with reference to the markets, thus rendering successful competition impossible.

It will thus be seen that definite knowledge of the factors which influence the ripening period may be of great importance in considering the adaptability of varieties for particular purposes. For such reasons as these the fruit grower must consider not only whether a variety will do well under the conditions where he wishes to grow it,

but also whether he can place it upon the market at a time when remunerative returns will be reasonably assured.

It will thus be seen that the success of a variety must be measured by two standards—its ability to develop to a high degree of perfection and its commercial value in terms of profit and loss when placed upon the market. Under the conditions which exist in some particular locality, a variety may reach such a high state of perfection that little else could be desired so far as intrinsic merits are concerned, yet because of its season of ripening, lack of transportation facilities, or some other cause apart from the inherent qualities of the fruit itself it fails to yield a profitable financial return when offered for sale in the open market. While such a variety would be considered successful so far as its growth is concerned, it is at the same time unsuccessful as a commercial sort under these conditions, because it fails to meet the end desired of it. In some other locality where the opposing features do not exist it might yield a satisfactory financial gain, and hence be successful from a commercial standpoint.

A similar parallel might be drawn in regard to a variety intended for home use. However well the tree may grow or the fruit develop, if it fails for any reason to meet the desired end it can not properly be considered a successful variety to grow for that purpose.

In the varietal notes on later pages the necessary distinctions relative to what constitutes the "success" of a variety are made.

Many illustrations might be given of the fact mentioned in our initial statement that the conditions under which a variety of fruit is grown have a decided influence upon its behavior and value, and consequently upon its desirability for a given purpose, but the foregoing is sufficient to explain the nature of fruit district investigations. Their object is obvious. Briefly summarized, they are an effort to ascertain the limitations within which fruit varieties may be profitably planted, as indicated by the manner in which they respond to the influences of their environment, an effort to determine the adaptability of different varieties to different conditions and combinations of conditions.

It is not sufficient, however, to know merely that a certain variety is successful or unsuccessful, as the case may be, in a certain place. It is equally necessary to know, in as much detail as practicable, what the exact conditions are under which it is grown and to determine with all possible accuracy what each factor contributes to the success or the failure of the variety in question. This involves consideration of slope, soil, elevation (both actual and comparative), temperature, humidity, and all the other factors included in the term "climate," besides such other incidental or local conditions as may influence varieties in any way. The aim of these investigations is to

thus work out the requirements, in all the detail possible, of the different varieties of fruits, especially those varieties which appear to be of greatest commercial importance, for the purpose of aiding fruit growers in selecting those sorts which will be the most profitable and satisfactory for the purpose for which they are desired.

Incidental to the study of the adaptability of the more important and better-known varieties to the conditions which may affect them, these investigations also include a consideration of new and little-known sorts. New varieties of which but little is known concerning the requirements or their range of adaptability are being constantly introduced. Many varieties having decided merit where they are now grown are known only in the localities in which they originated. So far as practicable such varieties are investigated and their usefulness in the development of the fruit-growing interests of the country determined.

Again, a large majority of the varieties which are grown for commercial purposes are defective in one or more important features. For instance, the "Elberta" peach and the "Ben Davis" apple lack high dessert quality, yet both possess characteristics which render them valuable commercial sorts. Some are not sufficiently productive; others do not stand shipping sufficiently well; still others, which are desirable in most respects, develop faults in cold storage. Some defect might be mentioned which would apply to nearly every sort found upon the market at the present time. While the attainment of some preconceived ideal in any kind of fruit may not be possible, an effort made in the direction of a desired end can not fail to produce beneficial results. It is hoped that in these minute studies concerning the requirements which are necessary for the development of varieties to their highest degree of perfection, sorts may be discovered and introduced into the various commercial districts of the country which will not possess the more conspicuous defects of the important commercial varieties now in general cultivation.

In some sections the "variety problem" is a comparatively simple one, even over large areas, as in the prairie region of the Central West, where the soil conditions are fairly uniform and the elevation and other factors of influence are not sufficiently variable to require special consideration. But some of the mountainous regions offer the best locations for the growing of particular fruits, and in these regions the question of varieties becomes an exceedingly difficult one because of the great variation in the soil, the constantly changing elevation at which it is desired to grow fruit, and the corresponding lack of knowledge regarding many other conditions. The Piedmont and Blue Ridge regions of Virginia and the South Atlantic States represent such a section in the East. Numerous illustrations occur in the West. Under

such conditions only the most careful discrimination in the selection of varieties can give reasonable assurance of success, and in many instances the necessary information essential to the making of such discrimination is not yet obtainable. While a variety may be well adapted or not to the more or less broadly defined fruit districts into which any region, or even the whole country, may be divided, local factors often cause wide differences in its behavior in different localities within such a district. Where the soil lacks uniformity, where differences exist in slope or elevation, or where there is some special local condition, a variety may reach a high degree of perfection in one locality while it is practically worthless in another portion of the same orchard.

In the earlier days, when fruit growing was merely an incidental factor of farm life, it mattered little whether the orchard or fruit plantation bore an abundant crop or not. But little was expected, and if that little was received it was satisfactory. Within comparatively recent years the point of view has entirely changed, and with this change fruit growing has developed into a business quite distinct from general agriculture. It has become of increasingly great importance to the commercial interests as new regions have been developed, fruit growing in all its branches extended, and competition increased that every tree, shrub, bush, and vine should produce its maximum crop, maturing just at the right time and being of such quality and appearance that when offered for sale it will bring a maximum price. The more complete one's knowledge is of the different varieties of fruit and their requirements for the highest degree of development, the more nearly can these ideals in fruit growing be realized.

Another important factor to be considered is the "personal equation." The characteristics and ideals of the grower are potent influences in the behavior of the varieties under his care, and consequently upon their apparent adaptability to the local conditions under which they are grown. While soil, climate, and other features which in any way influence varieties are important and largely beyond the control of the planter except as he can meet these conditions by selecting properly adapted varieties, it frequently happens that the one determining factor in the success or failure of a variety is the way in which it is handled and cared for; in other words, the man himself. The grower in many ways controls the conditions under which his fruit develops, and no two men are likely to produce just the same conditions, even though the natural possibilities are the same. Hence it is that a variety under certain treatment will produce certain results, while in an adjoining orchard under other treatment the results may be very different. A single example will illustrate the point in question.

Two orchards are located side by side, both having similar natural advantages. One is well cultivated and sprayed; the other unsprayed and the soil impoverished. The fact that the fruit of a variety in the first orchard is large, finely developed, and free from insect and fungous defects and that in the second the same variety is small, imperfectly developed, and rendered worthless by its apparent susceptibility to some disease or insect is not due so much to the inherent merits or faults of the variety in terms of its commercial value for that particular locality as it is to the man in charge, as measured by the methods employed in caring for his orchard.

These fruit district investigations have a twofold basis of application. On one basis a variety is considered from the standpoint of its commercial value, and the influence upon it of the artificial conditions imposed by cultivation, spraying, and the other operations which go to make up the present-day progressive methods of orchard management is taken into account. By these methods the grower is able to overcome in a measure the natural or inherent susceptibility of a variety to disease and other kinds of imperfections. In this view of the case, the chief concern of the grower is to know that the variety in question will respond readily and completely to the influence of the artificial conditions which he is able to maintain and that under such conditions the commercial value of the crop will be relatively large in proportion to the cost of production.

The second point of view is the scientific aspect of the adaptability of varieties. In this phase of the investigations a variety is considered not under the forced conditions of a highly cultivated orchard with the application of every practicable means for increasing and perfecting the product, but rather under conditions where influences imposed by man are eliminated as completely as possible. If a variety thus develops under natural conditions—that is, with no special attention from man—its behavior may be taken as the expression of its innate characteristics and capabilities when grown under the natural conditions of soil, climate, etc., which exist in the particular place where it is grown. The ability of one variety over another to resist some disease, to develop to some special degree of perfection, or to manifest some other individual peculiarity is frequently noted in orchards which are in a much-neglected condition. While the commercial aspect is of the greater importance from a pecuniary point of view, the scientific phase is in reality the fundamental consideration. In conducting the investigations, the aim is to give each aspect the weight of its true significance.

As previously implied, the fundamental principle underlying the fruit district investigations has long been recognized and much valuable information accumulated in regard to the requirements of

many varieties of the various kinds of fruits. Much of the effort, however, which has been expended in this direction has been without definite system or plan, although in a comparatively few instances careful and systematic effort has been put forth toward the solution of specific problems. The efforts of a relatively small number of specialists have also been directed along certain well-defined lines. There has been little attempt, however, to correlate cause and effect, so that the practical application of the underlying principles in the adaptability of varieties to their environment has not been possible in any considerable degree in the selection of varieties for the extension of the fruit-growing interests to new territory.

The most comprehensive attempt to compile the available information relative to the adaptability of the varieties of the different kinds of fruits to the various sections of the country is the work that has been done by the American Pomological Society during the last half century through its committees appointed for the purpose. The result of these efforts has been published in the catalogue of that society from time to time and also in its most recent revision as Bulletin No. 8, Division of Pomology, of this Department. In these publications the country is divided into nineteen districts, and the varieties of the more common kinds of fruit which are considered best adapted to the different districts are recommended for planting. For obvious reasons these recommendations are general and do not take into account the local conditions which may exist in the districts.

The efforts of the Bureau of Plant Industry in its fruit district investigations are similar in many respects to the work done by the American Pomological Society in this direction, but the scope of the research carries the inquiry farther and considers in the minutest detail practicable the peculiarities and the requirements of varieties, and attempts, as far as possible, to correlate cause and effect. It thus becomes possible, within the limits of the information at hand, to select varieties with a view to their value in very restricted sections having local peculiarities as well as for the larger and more or less general districts now recognized.

SCOPE OF THE PRESENT INQUIRY.

This paper is a preliminary consideration of the territory under discussion. The conditions and their influence upon the varieties of the different kinds of fruit grown therein have not been studied in sufficient detail or for a sufficiently long period of time to warrant the making of many deductions which are not subject to revision as conditions become known more intimately and the varieties are studied under a wider range of climatic influences. It seems advisable, however, to issue a summary of the observations which have thus far been made.

In these investigations acknowledgment is due and gladly made of the assistance which the writer has received from numerous sources. The fruit growers of the regions under consideration have granted him the freedom of their orchards without restraint for the making of personal observations, and they have also given freely the results of their experience. In the identification of varieties, by helpful suggestions, and in many other ways the assistance of his associates in office has been invaluable.

The data for the following deductions have been obtained in various ways, but mainly by means of careful observations and studies of the varieties and their environments through personal inspection of the orchards, these studies being supplemented by the results of the experience and impressions of the growers as learned from them in interviews and by correspondence. The ideal method of investigating the adaptability of a variety is to study it from time to time during its development throughout the entire season, but as only a single inspection each year is practicable in most cases, the examination is made as nearly as possible when the fruit is mature, but before it has been harvested. The immediate local conditions under which the fruit has developed can then be best determined, and also their effect upon the varieties.

THE PHYSICAL AND CLIMATIC CONDITIONS OF THE PIEDMONT AND BLUE RIDGE REGIONS.

To say that a variety of fruit succeeds in any particular place or seems to be poorly adapted, as the case may be, signifies little or nothing in regard to the real merits of the variety in extending or developing the fruit industry, unless the conditions under which the variety is grown are also known. Its reported behavior may be the result of conditions which are entirely within the control of man and not necessarily subject to any natural features of the location where it is grown. On the other hand, the variety in question may be considered for planting in some other section where the conditions are similar to the location where it has produced known results. It then becomes of fundamental importance to be able to forecast, by a comparison of conditions and their influence upon the variety, what its value is likely to be for the purpose desired in the second locality. Hence, the behavior of a variety must be interpreted in terms of the conditions under which it is grown in order that its behavior shall have definite significance. It is therefore necessary to describe in considerable detail the more important conditions which exist in the regions under discussion, that the varietal notes which occur on later pages may have the widest possible application.

PHYSICAL DESCRIPTION OF THE REGIONS.

From a geological standpoint, Virginia and the South Atlantic States are divided into several regions. The natural physical divisions result from the geological formations, and hence conform closely to the geological regions in their extent. There are no sharply defined lines of demarcation between these different regions, each one extending by almost imperceptible gradations into the adjoining ones. The general direction in which they extend is parallel to the coast line.

What may be termed the "pomological regions" of these States are nearly coincident with the physical regions, and hence they may properly be referred to in the present connection.

The points wherein the physical and pomological regions do not correspond in location coincide mainly with differences in elevation. The map shown as Plate V indicates the location and extent of the pomological regions as nearly as it is possible to outline them from available data. By studying the contour lines, the approximate elevation and topography of any section within the boundaries of each region can be determined without difficulty. The relief map shown in Plate IV may also be of assistance in studying the topography of the territory under consideration.

The three most important divisions or regions which are common to all the States under consideration are called by various terms, but most frequently they are spoken of as the Coastal Plain, the Piedmont, and the Blue Ridge regions. These divisions are variously subdivided by different authors, but it is not necessary to consider them in detail in the present connection. It may be well, however, to note that in the Virginia section the eastern portion of the Piedmont region is frequently referred to as middle Virginia, thus restricting the Piedmont region to a relatively narrow strip of country adjacent to the Blue Ridge Mountains. There are also two other natural divisions which should be mentioned, one of which is known as the Appalachian Valley, while the other includes the Allegheny and Cumberland plateaus.

The Coastal Plain extends the entire length of the coast line of these States and varies in width from a few miles to 150 or 200 miles at some points. It is generally level, and the greater portion of its surface is but a comparatively few feet above sea level, except along its western limits, where it grades into the Piedmont region; here it reaches an elevation of about 500 feet at some points.

The section of the map (Pl. V) indicated by the lighter horizontal hatching (see legend on map) comprises the Coastal Plain and that portion of the Piedmont region which is below 500 feet elevation. In Virginia this includes a considerable section that belongs geologic-

ally to the Piedmont region, and to a lesser extent the same thing is true in North Carolina. The soil is mostly a light sandy type.

The Piedmont region lies between the Coastal Plain and the Blue Ridge. The border line between this region and the Coastal Plain may be said, for present purposes (though not geologically accurate), to extend in Virginia from Alexandria southward, through Richmond and Emporia, which is near the southern boundary of the State, across North Carolina and South Carolina in a southwesterly direction in the vicinity of Columbia, S. C., and into Georgia near Augusta. The border line between these two regions marks the position of the seacoast in former ages, the Coastal Plain being of comparatively recent geological origin.

The western boundary of the Piedmont region must be indicated in even a more arbitrary manner than the eastern since it is largely a matter of elevation, those points having 1,000 feet or less being generally considered in the Piedmont and those having a greater elevation than this in the Blue Ridge.

The topography of the Piedmont region is somewhat broken and rolling. (See Pl. II, figs. 1 and 2.) The elevation ranges from 150 to 500 feet along its eastern extremities adjacent to the Coastal Plain to 1,000 feet in proximity to the Blue Ridge. Numerous hills project above the general level, and some of the spurs of the Blue Ridge extend within its borders. (Pl. III, fig. 1.) Many streams rising in the mountains cross it, mostly in a southeasterly direction, while a large number of smaller streams and tributaries have their origin within the region itself.

The section of the map (Pl. V) indicated by the heavier diagonal hatching represents the pomological region which is most nearly coincident to the Piedmont. Its eastern border follows closely the 500-foot contour. Throughout nearly all of Virginia its western extremity has an elevation of about 1,000 feet, except south of the Roanoke River. From this region to its southern extremity in northern Georgia, its division from the adjacent region is made to follow in a general way the 1,500-foot contour because of the behavior of the fruits grown therein. The most common type of soil is a stiff red clay with various modifications containing more or less sand.

It should be stated in this connection that a majority of the orchards in the Piedmont region are confined to a relatively narrow strip, lying in comparatively close proximity to the mountains, where the elevation ranges from about 800 to 1,000 feet; hence the investigations in this region have been limited in their extent by the distribution of the orchards.

The Blue Ridge region included in this discussion, as it extends from the northeast to the southwest through Virginia, is contained in the Piedmont and Valley counties which have common boundaries

upon its crest, except in the southwestern portion of the State, where it expands into a relatively broad plateau. This same plateau extends across North Carolina, having its western boundary within the borders of eastern Tennessee. The Blue Ridge Mountains, which extend nearly the entire length of this region, with their foothills and spurs, constitute its eastern boundary. The range is more or less broken by spurs, ridges, detached knobs, and foothills having various altitudes. The highest point of this range in Virginia is "Flat Top" (Peaks of Otter), in Bedford County, with an elevation of 3,993 feet. (See Pl. I.) There are several other peaks having altitudes considerably above the general average of the range. In this portion of the region the investigations were confined principally to the eastern watershed of the range.

In North Carolina, with its boundaries extending from the Blue Ridge to the Smoky Mountains, the Appalachian Mountain system reaches its culmination. This plateau is divided by cross ridges, thus making smaller plateaus, each bordered by mountains and having its own system of drainage. Numerous peaks extending far above the general elevation of the mountains characterize the topography. There are 43 peaks within the State, each having an altitude exceeding 6,000 feet, including Mount Mitchell, with an elevation of 6,711 feet, which is the highest point east of the Rocky Mountains. There are a large number having altitudes only a few hundred feet less than this. The extremely rugged character of this section of the region is therefore apparent.

In South Carolina the Blue Ridge region is confined to a comparatively narrow strip following the northwestern boundary of the State. This is less rugged than the corresponding section of North Carolina, but includes several peaks of considerable altitude, the highest of which is Mount Pinnacle, having an elevation of 3,436 feet.

In northern Georgia the Blue Ridge region comprises the southern extremities of the Appalachian system. It is less rugged than the more northern portions of the system and naturally of lesser altitude, as it sinks into the lower levels of central Georgia.

On the map (Pl. V) the section indicated by vertical hatching represents mountain conditions and comprises the Blue Ridge Range with its spurs and detached knobs. The elevation is from 1,000 to 1,500 feet on its eastern border, as previously indicated, to 4,000 feet, though this elevation is seldom found in this region except in North Carolina. The elevation of the western border along the adjacent region is considered to correspond in elevation essentially to the eastern border. The soils are variable, representing several types, but as a rule they are rather loose and friable and well adapted to the growing of fruit.

It is in the foothills and on the lower slopes of the Blue Ridge, especially in the Virginia and North Carolina sections, that the fre-

quently mentioned "cove" orchards are located. (Pl. III, fig. 2.) These coves are the valleys between the ridges and spurs which extend from the main ridges. As a rule they are narrow, but often of considerable length. Usually the soil is a deep, black, friable loam and extremely rich. These coves are considered very desirable locations for orchards.

The section of the map (Pl. V) indicated by the lighter diagonal hatching represents the mountain region included in the Allegheny and Cumberland plateaus. It requires no special description in the present connection, as it is not included in the following discussion. The same statement applies also to the Appalachian Valley region. Geologically this valley is continuous throughout the entire length of the mountain system, but because of its elevation in southwestern Virginia it is considered a more accurate pomological representation of this section to place this portion of Virginia in the Blue Ridge and other mountain regions, as the map indicates.

The small, detached, green areas (Pl. V), found principally in North Carolina and West Virginia, indicate points exceeding 4,000 feet in elevation. There is but little attempt made to grow fruit at these higher altitudes because of their inaccessibility and the unfavorable climatic conditions which often prevail. Hence these areas are relatively unimportant from the standpoint of commercial orcharding, though it is probable that some varieties would prove to be adapted to these conditions, aside from periods of injurious climatic conditions, such as sleet storms, etc.

THE SOILS.

The relationship of soil to crop production is a matter of increasingly great importance, and the practice of selecting a particular type for the production of a specific result is constantly being given wider application in the most progressive lines of agriculture. While it may be true that the most marked influences of different soil types appear in the growing of annual crops—those which complete their life cycle in a single season—the effects of soil are also frequently noticeable and of great consequence in the production of such crops as orchard fruits, which occupy the land for a series of years. This fact is becoming better appreciated by fruit growers, and greater care is being exercised than formerly in selecting soils for orchard purposes. A soil rich in available plant food is essential to the best results, but doubtless its physical condition, in relation to its heat and moisture absorbing capacity, is of still greater significance than the mere quantity of plant food which it may contain.

In these Piedmont and Blue Ridge regions the soil types are numerous and variable. Two areas in the Virginia portion of these regions

have been surveyed and mapped by the Bureau of Soils[a] of this Department. One of these areas includes the principal fruit-growing portions of Albemarle and Nelson counties, and the other an important portion of Bedford County. The types of soil described and mapped in these two areas are fairly typical of much of the territory included in this discussion.

The description of the soil types which follows is condensed from the reports of Mooney, Martin, Caine, and Bonsteel and represents the soils of these regions which are the most important to the fruit-growing interests concerned.

CECIL LOAM.

Cecil loam has a wide range of color, but the greater part of it has a yellowish, light or dark brown, reddish brown, or red shade. The surface soil varies from 6 to 12 inches in depth, averaging probably about 10 inches. It usually contains fine sand, and occasionally in proportions great enough to give the soil a somewhat sandy character. The subsoil also varies in color and texture. The principal type is a yellowish, occasionally slightly reddish, loam, grading into rotten rocks at a depth generally less than 36 inches. In the upper part of this loam subsoil there is a stratum of heavy texture, but beneath this the subsoil becomes lighter as depth increases. The soil and subsoil contain a large quantity of finely divided mica. It is a Piedmont soil, found in Virginia in Nelson and Albemarle counties, and in some other sections it extends well up the slopes of the foothills in many instances.

CECIL CLAY.

Cecil clay is the most important soil type in the Piedmont region. It is locally known in Virginia as "red land," and is the best of the Piedmont soils for general farming purposes. It is found on the rolling uplands, in the smaller stream valleys, on the slopes of the small isolated mountains of the plateau, and on the gentle slopes of the large mountains to an elevation of 1,000 feet above sea level. The soil is residual, derived from the weathering of granite, gneiss, schist, diabase, and other metamorphosed rock. It varies from a heavy, reddish brown clay loam to a stiff, tenacious red clay of varying depth, but with an average of 8 inches. The subsoil is a stiff, tenacious red clay to a depth of 36 inches or more. Sharp quartz sand and rock fragments are found in both soil and subsoil. Mica is usually present in the subsoil.

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[a] Field Operations of the Bureau of Soils, U. S. Department of Agriculture, for 1901, pp. 239–257; also Field Operations for 1902, pp. 187–238.

CECIL SANDY LOAM.

Cecil sandy loam is locally known in Virginia as "gray land." It occurs usually in small areas in the same section as Cecil clay, on level uplands and gentle slopes of the mountains. Its origin is the same as Cecil clay. The soil is a gray to yellowish sandy loam, the sand particles varying from fine to coarse. The average depth is about 6 inches. Fragments of angular quartz and of some other rocks are found upon the surface in varying quantities. The subsoil varies from a clay loam to a stiff, tenacious red clay. It is less fertile than Cecil clay as a rule and not well adapted to the growing of fruit.

PORTERS BLACK LOAM.

Porters black loam is found in small areas on the mountain tops and in depressions on their sides, usually at heads of mountain streams. It is a brownish black or jet-black loam, having a depth of several feet in some places, while in others it occurs merely as pockets of loam in the midst of huge bowlders. It is also commonly found in the coves and hollows between the mountain ridges. The average depth is about 15 inches. The subsoil varies from a yellowish brown clay loam to a reddish color. The soil is residual, being derived from the weathering of coarse-grained granite, gneiss, and other eruptive and altered rocks. Rock fragments from which the soil has been derived are found both in the soil and subsoil. This is the type commonly called "pippin land," because of the high degree of perfection to which the Yellow Newtown ("Albemarle Pippin") apple develops on it.

PORTERS CLAY.

Porters clay is similar to Cecil clay, but contains a larger percentage of bowlders. It is associated with other mountain soils on the slopes, generally at elevations exceeding 1,000 feet. The soil is a clay loam, of a reddish brown to red color, averaging 6 inches in depth. The subsoil is a stiff, tenacious red clay. Both soil and subsoil have been derived from granite, gneiss, schist, and other metamorphosed and eruptive rocks.

PORTERS SAND.

Porters sand is primarily a mountain type of soil, though considerable areas of it are also within the Piedmont region in certain sections. It is a residual soil consisting of a gray or yellowish sand, averaging about 8 inches in depth. The subsoil is usually a coarse, yellowish sand, which as a rule runs into disintegrated rock at a depth of 3 feet or less. Rock fragments are generally present in both soil and subsoil. On some of the lower slopes the fragments are small, giving the soil a gravelly character.

PORTERS SANDY LOAM.

Porters sandy loam is on the tops and sides of the mountains and comprises about three-fourths of the mountain area. It varies from a gray sand to a yellowish gray sandy loam, about 10 inches in depth. The subsoil is much the same as the surface soil, but in places grades into a reddish sand, becoming coarser in the lower depths. Angular fragments of rock similar to that from which the soil and subsoil have been derived are quite abundant.

MURRILL SANDY LOAM.

Murrill sandy loam is found on the uplands of Goose Creek Valley (Bedford County, Va.) and on the lowest slopes of the Blue Ridge Mountains. It is of heterogeneous origin. The subsoil is derived from the weathering of limestones and shales, and the soil from sand washed down from the slopes of the mountains upon the residual material. The subsoil varies from a red clay loam to a soft, sticky red clay, while the soil varies from a fine gray sandy loam to a coarse yellow sandy loam, depending upon the kind of rocks from which it is derived. Its average depth is from 8 to 15 inches. The soil is more or less rocky.

MURRILL CLAY LOAM.

Murrill clay loam is the most important soil type in Goose Creek Valley (Bedford County, Va.), but the areas are small except in one or two locations. It varies from a light to a dark brown clay loam, with an average depth of 10 inches. The subsoil is a brownish yellow clay loam, increasing in clay content with the depth. Fragments of shale and particles of chert are frequently found in it. The origin is partly residual from shaly limestone and partly sedimentary from the wash of the higher slopes along the borders.

A number of other types which are of value for fruit-growing purposes occur in these regions farther south than the soil survey referred to extends, but most of them are similar to types already described. Throughout the Piedmont region the prevailing type is Cecil clay or some slight modification of it. Cecil sandy loam and slight variations of it also frequently occur. In important sections of northeast Georgia the soil posseses but a small clay content, and instead of Cecil clay the most important type is a very red, loose, friable loam, containing more or less decaying rock fragments and possessing more than a usual degree of fertility. This soil is deep and the subsoil is similar to the surface soil. The areas of this type are intersected in many places by a more sandy loam. It extends into South Carolina, but the proportion of the more sandy types to the heavier loam is probably greater than in Georgia.

While the mountain soils at points south of Virginia are more variable than those of the Piedmont region, they generally possess the loose, friable character of the mountain types which are found in the Virginia section of the region previously referred to. In some places a heavier clay soil than is usually the case in Virginia is found at considerable elevations.

THE CLIMATE.

In the Encyclopedia Americana, Moore defines climate as the sum of the atmospheric conditions as recorded for a long period of time, or "the totality of the weather." Weather is the physical condition of the atmosphere at a given time or for a limited period. We speak of the weather of to-day or of last week, and the weather which prevails in a place for an indefinitely long period of time makes the climate of that place. Climate includes, as stated by Moore, "atmospheric pressure, temperature, rainfall, snowfall, time and frequency of frosts, extremes of heat and cold, direction and velocity of wind, the amount of air that flows from the different points of the compass, amount and intensity of sunshine, humidity and transparency of the atmosphere, and its electrification."

It has been said that climate affects the health, happiness, and well-being of people more than any other factor that enters into their environment. If this is true of climate in its relation to man, who is able, in a measure, to protect himself against adverse climatic conditions, it is obvious that it has a still wider application in relation to plant life, with which there is no self-protection except by slow adaptation.

That climate, or some element of it, is an important factor in controlling the distribution of plants, both cultivated and wild, is readily apparent. For instance, those fruits which are characteristic of the Temperate Zone are not able to endure the low temperature of the extreme north or the relatively high temperature of lower latitudes. The same is true of the fruits which are native to tropical or subtropical regions. Moisture is equally as potent as temperature in determining the range of plant growth, whether it be orchard fruits or wild plants. This is seen in the behavior of plants during severe drought or of plants native to a humid climate as they approach their limits of growth in the direction of arid or desert regions.

Between the extremes of temperature and moisture, together with the other elements of climate, there is every possible gradation, and the infinite number of combinations of temperature and moisture are manifested in some degree in terms of plant life. At one extreme there is an abundance of heat and a minimum of moisture, producing desert conditions where only specialized forms of plant life can endure. At the other, a maximum of both heat and moisture, where the lux-

uriant growth of the rainy tropics prevails. With a minimum of heat and moisture in the form of ice and snow, moss and other plants of a relatively low order prevail, as in the Arctic region.

The rainfall of a place is influenced largely by the configuration of the earth's surface, the direction and height of mountain ranges, and the direction of the prevailing winds. The temperature is governed mainly by latitude, elevation, and proximity to large bodies of water, especially if these are very deep. However, the necessary combinations of temperature and moisture to produce a maximum plant growth or crop of fruit seldom, if ever, exist. The combination which would produce the greatest vegetative growth might not be the most desirable for fruit production.

Slight differences in climate, especially in temperature and moisture, often make great differences in the development of plant life. In this connection, however, it should be noted that a high temperature for a relatively short period often hastens maturity more than a higher mean temperature which does not reach the requisite extreme for a short period. In other words, within the climatic range of a plant the mean temperature is of less relative importance than a suitable range of temperature during the critical periods of the plant's life.

Comparatively slight differences in moisture are equally conspicuous, as when a "timely rain" insures the perfect development of some crop and in the absence of such a rain a light harvest is the result.

While such readily apparent results may obtain only with those crops which complete their growth in a short period, they at the same time emphasize the fact that climate has much to do with the development of plant growth. And what is true in principle in its relation to plants which mature in a short period of time is also true in principle in its relation to plants, such as orchard trees, which require a long period to fulfill their purpose. This is especially noticeable in the relative times at which the annually recurring epochs, such as blossoming, putting forth of the leaves, ripening of the fruit, etc., take place from year to year.

There is an unfortunate lack of data relative to climatic conditions which actually exist in orchards. Nearly all the available climatological records have been made at stations located in towns or at points more or less distant from orchard sites; hence, the best available records frequently do not accurately represent the climatic conditions which have prevailed in orchards, even in the sections where the records have been taken. Such records, however, are not without value for the present purpose, inasmuch as they furnish a means of comparison, in a general way, of different fruit-growing sections. Tables I, II, III, and IV, giving a monthly summary of the maximum, minimum, and mean temperatures and amount of precipitation, are taken from the Monthly Weather Review issued by the Weather Bureau

of this Department and are of interest in showing certain general climatic features of the Piedmont region. Corresponding data from the Coastal Plain are also inserted for comparison. As will be noted, the records are the monthly summaries for the years 1902 and 1903. The records of not less than two years are desirable for such comparison, because of the climatic differences which frequently occur from year to year, even in the same locality. The special reason for selecting the data for 1902 and 1903 in the present case is because of their application to the phenological data appearing on later pages.

TABLE I.—*Climatological records for Bedford City and Petersburg, Va., 1902 and 1903.*

	1902.				1903.			
	Temperature.			Precipitation.	Temperature.			Precipitation.
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.	
Bedford City (elevation, 947 feet; approximate latitude, 37½°):	°*F.*	°*F.*	°*F.*	*Inches.*	°*F.*	°*F.*	°*F.*	*Inches.*
January	55	13	34.6	....	65	12	36.2	5.14
February	68	12	33	5.40	70	6	41.9	5.48
March	75	19	48.4	3.86	79	29	53.6	5.63
April	90	32	55.1	1.73	89	25	57.4	2.92
May	95	41	69.6	1.91	98	38	68.8	.77
June	102	46	73.6	4.58	91	45	70.4	8.04
July	101	56	79.6	2.49	100	51	79.2	1.79
August	96	53	76	2.34	98	56	76.8	4.06
September	95	39	68.3	1.94	92	40	70.1	2.97
October	82	35	58.8	6.52	84	35	60	....
November	78	25	54.5	2.17	80	19	45.8	....
December	65	12	38.1	2.86	50	12	33.2	....
Petersburg (elevation, 14 feet; approximate latitude, 37¼°):								
January	69	14	36.8	2.95	58	16	36.9	2.72
February	69	7	34.4	5.67	72	10	42.2	5.52
March	81	17	50.9	2.60	77	25	53.7	8.11
April	89	29	56.2	3.53	89	37	57.2	4.63
May	92	43	67.6	3.86	98	40	66.8	3
June	98	51	72.7	3.47	87	48	69	10.25
July	101	56	79.4	3.87	96	57	77.9	4.31
August	97	54	74	4.42	99	62	75.5	4.85
September	90	42	68.2	4.43	89	40	69.4	3.12
October	83	31	61	2.53	85	31	58.8	4.45
November	79	26	55	2.50	77	18	45.6	1.33
December	68	17	40	3.32	58	15	35.2	2.52

TABLE II.—*Climatological records for Lenoir and Kinston, N. C., 1902 and 1903.*

	1902.				1903.			
	Temperature.			Precipitation.	Temperature.			Precipitation.
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.	
Lenoir (elevation, 1,186 feet; approximate latitude, 35¾°):	°*F.*	°*F.*	°*F.*	*Inches.*	°*F.*	°*F.*	°*F.*	*Inches.*
January	68	10	37	2.80	64	10	36.6	5.06
February	67	9	33.7	2.66	70	9	40.6	8.80
March	77	20	47.8	4.23	76	23	53.4	11.15
April	84	27	51.8	1.73	82	19	53.8	5.36
May	93	41	69.4	2.33	96	42	67.6	.74
June	96	47	70.8	6	89	42	62.4	4.69
July	96	52	73.5	1.99	93	51	75.4	4.16
August	96	51	74.8	.90	94	58	75	4.87
September	93	37	66	4.17	90	38	67	2.49
October	84	31	58.3	4.82	....	....	....	3.10
November	79	26	53.1	4.11	80	12	44.8	3.06
December	....	....	....	....	60	10	36.9	1.87

TABLE II.—*Climatological records for Lenoir and Kinston, N. C., 1902 and 1903*—Con.

	1902.				1903.			
	Temperature.			Precipitation.	Temperature.			Precipitation.
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.	
Kinston (elevation, 45 feet, approximate latitude, 35¼°):	° *F.*	° *F.*	° *F.*	*Inches.*	° *F.*	° *F.*	° *F.*	*Inches.*
January	73	15	41.3	1.01	71	18	43	2.96
February	76	19	38.4	6.70	74	16	48.4	5.91
March	83	22	54.9	3.04	81	34	60	8.05
April	89	30	61.2	2.34	86	30	56.7	2.99
May	97	44	72.8	2.64	95	45	67.6	3.91
June	100	50	77.5	3.92	....	....	....	....
July	104	60	82.6	2.69	97	60	79.4	8.07
August	99	52	78.6	8.91	97	62	79.6	6.83
September	91	46	72.6	2.76	88	41	71.5	.89
October	84	31	62.9	5.13	86	27	57.4	3.28
November	81	31	57.2	4.14	....	14	....	....
December	71	16	45.5	1.82	63	15	36.2	1.99

TABLE III.—*Climatological records for Conway, S. C., 1902 and 1903.*

	1902.				1903.			
	Temperature.			Precipitation.	Temperature.			Precipitation.
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.	
Conway (elevation, 25 feet; approximate latitude, 33⅞°):	° *F.*	° *F.*	° *F.*	*Inches.*	° *F.*	° *F.*	° *F.*	*Inches.*
January	80	18	43	1.16	75	21	46.4	4.24
February	77	20	42.2	5.81	77	23	51.2	3.75
March	82	25	55	3.25	80	38	62.8	5.59
April	86	33	60.6	1.08	87	34	60.8	2.50
May	94	48	72	2.50	99	49	70.4	1.60
June	100	57	77.1	4.20	94	52	75	4.74
July	104	64	82.1	1.80	98	59	80.2	2.20
August	98	59	79.4	8.25	100	65	81.5	8.42
September	92	54	73.4	6.03	93	49	72.6	1.88
October	87	35	66.2	5.94	85	29	61.5	3.34
November	82	31	59.6	3.94	80	15	52.2	.91
December	72	18	47.8	6.80	68	17	41.2	3.35

TABLE IV.—*Climatological records for Gainesville, Ga., 1902 and 1903.*

	1902.				1903.			
	Temperature.			Precipitation.	Temperature.			Precipitation.
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.	
Gainesville (elevation, 1,227 feet; approximate latitude, 34¼°):	° *F.*	° *F.*	° *F.*	*Inches.*	° *F.*	° *F.*	° *F.*	*Inches.*
January	60	20	38.7	2.83	66	16	38.5	4.09
February	59	15	35.5	9.40	65	15	43.2	11.81
March	68	21	48.2	9.40	71	31	55.4	12.17
April	83	33	57.2	1.76	81	34	56.8	2.80
May	92	47	72.1	3.41	91	46	67.5	4.79
June	98	59	76.8	2.01	89	45	70.4	6.03
July	99	62	80	3.85	95	60	78.4	2.15
August	99	62	78.1	3.02	95	65	78.4	3.83
September	92	48	69.2	7.05	93	47	69.8	4.98
October	80	36	61.2	3.26	....	....	....	....
November	73	28	56.2	4.31	72	17	47	3.10
December	64	14	42	6.15	55	13	37.2	2.41

By making general comparisons month by month among the several locations a fair understanding of the climatic conditions, so

far as they can be represented in tabular form, may be had. The usual extremes of temperature are made apparent, and some idea of the rainfall can be obtained in this manner. It should be remembered, however, that these data represent in most cases town conditions, not actual orchard observations. And, further, in considering the elements of climate, such as moisture and temperature, with respect to their influence on any plant, it is necessary to take into account the condition of the plant in question at the time or during the period in which the particular element prevailed. For instance, peach buds when completely dormant may endure a certain low temperature without injury. If, however, the same temperature prevails after the buds have started in the spring or following a warm period during the winter, they may be entirely killed.

While the climatological data just tabulated may approximate the conditions which prevail in the Piedmont orchards, they can not be applied to the mountain region. Accurate data applicable to the mountain orchards are as a rule even less readily obtained than those for orchards in the Piedmont region. It is not unusual, however, as observed by some of the residents of the mountain districts, for the temperature to drop considerably below zero during the winter at some of the higher altitudes. The character of the native growth indicates climatic conditions similar to more northern latitudes.

There are many local climatic factors which can be determined only by a close study of the localities in question, such as danger of or immunity from frosts, the usual course of local showers, and many other features of importance.

There is one feature noticeable in some portions of the mountain region that is worthy of special mention. This is the "green belt," "thermal belt," or "frostless zone," as it is variously called, which extends in many places along the slopes of the Blue Ridge and its spurs, with southeastern to southwestern exposures. Where this belt occurs many kinds of vegetation remain green for a considerable time after all vegetation both below and above has been killed by frost. It is not until the severe freezes late in the season occur that the plants in this belt are injured. Concerning this thermal belt J. W. Chickering, jr., writing in the American Meteorological Journal for October, 1884, quoting Silas McDowell, of Franklin, Macon County, N. C., says:

Amongst the valleys of the southern Alleghenies sometimes winter is succeeded by warm weather which, continuing through the months of March and April, brings out vegetation rapidly and clothes the forest in an early verdure.

This pleasant spring weather is terminated by a few days' rain, and the clearing up is followed by cold, raking winds from the northwest, leaving the atmosphere of a pure indigo tint, through which wink bright stars; but if the wind subsides at night the

succeeding morning shows a heavy hoar frost; vegetation is utterly killed, including all manner of fruit germs, and the landscape clothed in verdure the day before, now looks dark and dreary.

It is under precisely this condition of things that the beautiful phenomenon of the "verdant zone," or "thermal belt," exhibits itself upon our mountain sides, commencing at about 300 feet vertical height above the valleys, and traversing them in a perfectly horizontal line throughout their entire length, like a vast green ribbon upon a black background.

Its breadth is 400 feet vertical height, and from that under, according to the degree of the angle of the mountain with the plane of the horizon. Vegetation of all kinds within the limits of this zone is untouched by frost; and such is its protective influence that the Isabella, the most tender of all our native grapes, has not failed to produce abundant crops in twenty-six consecutive years; nor has fruit of any kind ever been known within these limits to be frost killed, though there have been instances where it has been so from a severe freeze. The lines are sometimes so sharply drawn that one-half of a shrub may be frost killed, while the other half is unaffected.

The same writer states, further, that—

The thermal belt must exist in all countries that are traversed by high mountains and deep valleys, as the natural causes that produce it are as infallible as those which produce the rainbow in the clouds, and the only reason why its visible manifestations are peculiar to our southern Alleghenies is the fact that their precocious spring vegetation is sometimes killed by frost, while the same thing does not happen in the mountains farther north.

The above statement that "the thermal belt must exist in all countries traversed by high mountains" may be too general, and the ultimate causes which produce it may not be as simple as this writer appears to think, though doubtless the explanation is contained in the influences which produce a stratification of air at different temperatures. However, the important fact to be noted is that in the mountain regions under consideration this green belt does exist to a greater or less extent and contributes its portion to the natural advantages for fruit growing which the region possesses.

Late spring and early fall frosts are other important factors to be considered in studying the climatic conditions of a section with regard to its suitability for fruit growing. Frequently it becomes a matter of local consideration, as when there are "pockets" or valleys into which cold air settles and from which it can not readily escape. Such places are subject to unseasonable frosts. In the application of this feature to the regions in question it is sufficient to say that as a whole there is comparative freedom from such frosts. It sometimes happens that during the winter, mild weather which causes the swelling of the buds is followed by disastrous freezes, but the more favorably situated portions of these regions may be considered as relatively free from such dangers and as little subject to extremes of temperature as any of the more important fruit-growing sections east of the Rocky Mountains.

THE POMOLOGICAL ASPECT OF THESE REGIONS.

The natural advantages of the Piedmont and Blue Ridge regions render them of special value for the growing of certain kinds of fruit. The elevation is relatively high, ranging from 150 to 500 feet where the Piedmont region joins the Coastal Plain to that of the loftiest peaks east of the Rocky Mountains. The more extensive types of soil are not only fairly fertile, but they possess physical characteristics which make them well suited to this purpose when the necessary attention is given to the selection of proper varieties for the different types. The climatic conditions are also favorable in a high degree to the growing of many kinds of fruit.

With these advantages of soil and climate there is also the advantage of relatively close proximity to the great markets of the East and to shipping points for the export trade. With good transportation facilities both north and south, successful competition with other fruit-growing regions is made possible.

Fruit growing in these regions, however, is only slightly developed in comparison with the possibilities which exist in this direction. The methods of orchard management are commonly faulty and not productive of the best results which the natural advantages make possible. Notwithstanding these conditions, large quantities of excellent fruit, but principally apples, are grown in some portions of these regions, notably in the Virginia and North Carolina sections, and to a lesser extent in the other States included in the territory under discussion. In the South Carolina section there are very few orchards of commercial size, while in northern Georgia commercial fruit growing has been given much attention during the past few years. In certain sections of the latter State peaches have been planted extensively; apples have not been planted as much, but the possibility of growing some varieties to a high degree of perfection has been clearly demonstrated. The rather loose, friable soils of the southern Blue Ridge region of this section of Georgia, together with an abundant rainfall and relative freedom from late spring frosts, make this section especially well suited to the successful growing of a great variety of Temperate Zone fruits.

THE VARIETY PROBLEM.

In the consideration of the varieties that have been observed under the conditions which exist in the regions in question, the following points should be noted.

When the study of the varieties was begun, the serious confusion existing in the nomenclature at once became apparent and has been encountered throughout these investigations. Frequently some local name has become attached in different sections to a well-known va-

riety, and these local names, varying in different localities, have added to the confusion. The aim has been, so far as possible, to properly identify these varieties and to refer to them in the following varietal notes under the leading names which conform to the rules of nomenclature of the American Pomological Society. The more common synonyms are also given in italics.

The varieties referred to in the pages which follow do not include all that are grown in the regions in question, but it is not known that any important ones are omitted. In some cases a variety has been mentioned during the course of these investigations by only one grower, and the information secured concerning it has been too meager to warrant any reference to it at this time. In other cases varieties have been omitted because their identity was uncertain, and in all this work the importance has been emphasized of knowing beyond reasonable doubt the correct identity of each variety under consideration. If this point be not insisted upon, the merits or demerits of a particular sort would frequently be ascribed to some other one, thus making the deductions unreliable. Still others have not been mentioned because of their lack of importance and the limited space. In this connection, however, it should be stated that it has not been possible to make personal examinations of many of the stone fruits or of the early-ripening varieties of apples which are mentioned, because of the fact that the later apples constitute the most important fruit crop of these regions, and it has been found necessary to make the field investigations with reference to the late apples rather than to the relatively less important stone fruits and early apples. Hence, in the majority of cases it has been necessary to depend almost entirely upon the information and experience of the growers for the data relative to these fruits.

An effort has been made to study the different varieties under representative conditions, but not all conditions could be observed. It must necessarily follow that where a variety is being grown on a different soil, at a different elevation, or even under some other method of treatment than those observed, there is likely to be a corresponding difference in behavior of the variety itself. Hence, the notes relating to varieties may not in every case accord with the experience of all the growers in these regions who are familiar with them.

APPLES.

Apples are by far the most important commercial fruit grown in the Piedmont and Blue Ridge regions under consideration except in northern Georgia, where peaches are relatively of greater importance. The range of varieties is large, though the commercial sorts which are extensively cultivated are relatively few in number. This territory,

especially the Blue Ridge region, is rich in local varieties and seedlings which are not being propagated in any nursery and are known only in the localities where they are grown. It is probable that some of these local sorts may fill an important place in the future development of apple culture in these regions. Some of them have received local names, but many have no particular designation. They present a most promising and attractive field for investigation, but are not considered, except in a few instances, in the following varietal notes.

VARIETIES.

Arkansas. Synonym: *Mammoth Black Twig.*

This variety—more commonly mentioned by its synonym than by its leading name—has been planted in but relatively few orchards. The trees are all comparatively young; hence the adaptability of the variety and its value in these regions have not yet been fully determined.

The tree is a fairly vigorous grower, making a rather broad, roundish head. The original tree, which is still standing and in a fairly healthy condition, though it has been badly broken by storms, is said to be nearly 80 years old. While it usually begins to bear more or less at 5 or 6 years of age, it has thus far proved a shy bearer in most cases in these regions and not more regular in bearing than many of the heavier producing sorts. The fruit is medium to large; nearly solid red when highly colored; good to very good; season, winter. The qualities of the fruit when well grown render it desirable either for home use or for market purposes, but lack of productiveness thus far in these regions renders it of doubtful value commercially.

Though generally beginning to bear at a comparatively young age, this variety appears from present indications to be less precocious at the southern extreme of these regions. This characteristic has been noted especially in northeastern Georgia on sandy loam soil with friable loam subsoil at an elevation of 1,400 feet. Under these conditions it is said to be a better keeper than the Winesap grown under similar conditions. Some trees located in Amherst County, Va., at an elevation of about 1,500 feet and on Porters black loam with red clay subsoil bore their third full crop of fruit when 11 years old. Larger crops are reported in this location than elsewhere in these regions. Other conditions of soil and elevation under which good fruit is produced are Porters clay with elevations of 1,000 to 1,500 feet, and Cecil clay, 800 to 1,000 feet altitude. Murrill clay loam and Cecil sandy loam having elevations of 1,000 feet do not seem to give as good results as the other conditions mentioned. The tendency to lighter bearing and greater susceptibility to disease is said to be more pronounced under the last-named conditions. The fruit is small and the trees unproductive in the southwestern part of North Carolina at an elevation of 2,500 feet or more. In Albemarle County, at points of 500 feet elevation, on Cecil loam, the Arkansas apple has proved unsatisfactory thus far, the claim being made that it lacks color and flavor.

These deductions must be accepted merely as indications of the tendency of this variety in the regions mentioned, not as definite conclusions, since, as already stated, the trees are still too young for the mature characteristics of the variety to manifest themselves.

Arkansas Black.

But very few of the orchards in these regions contain this variety. The only one in which it has been studied is located in the southwestern part of North Carolina. The soil in this orchard is a loose, friable, reddish loam; the elevation is from 2,600 to 2,800 feet. Under these conditions it possesses very little to commend it for any purpose,

the fruit being small and very susceptible to the scab fungus, and the tree, though fairly vigorous, is unproductive. As these same characteristics have been observed to a greater or less extent in some other sections of the country, it is apparent that this variety should be planted only sparingly until its value has been demonstrated. In some sections of the country, however, it has become of considerable commercial importance.

Baldwin.

Though one of the most important winter sorts in the North, the Baldwin apple is relatively unimportant in these regions. It is widely distributed throughout them in the older orchards, but especially in the Virginia portions. The tree is rather irregular in bearing in most of these orchards and the fruit frequently drops badly, particularly at the lower elevations. In the mountain orchards, fruit of exceptionally fine appearance for the variety is often produced. Its behavior in typical Piedmont and Blue Ridge locations is indicated as follows:

On Porters black loam at elevations of 1,500 to 2,500 feet, probably also on Porters sandy loam at similar elevations, fruit of high quality for the variety and of excellent appearance, which may be expected to keep until the holidays under favorable conditions is produced. Good fruit is produced on Porters clay at 1,500 feet elevation, but it does not have the keeping qualities of that from higher altitudes. In other sections, particularly in Bedford County, Va., it is growing to some extent on other types of soil, such as Cecil clay, Cecil sandy loam, and Murrill clay loam, with an elevation of 1,000 feet or less. Under these conditions it matures as early as September and frequently rots and drops before it is ripe. The fruit from such locations is inferior in flavor and appearance in comparison with that from mountain orchards. These characteristics appear in some degree in all the Piedmont soils and elevations from Virginia to Georgia, but a few growers who have the Baldwin apple in mountain orchards, particularly those in the northern portion of the Blue Ridge region, find it fairly satisfactory for local markets. There are other varieties, however, which are more reliable and better adapted to these conditions.

Ben Davis.

There are few varieties of fruit as widely distributed in as many sections of the country as the Ben Davis apple is, and in the Piedmont and Blue Ridge regions it is one of the comparatively small number of varieties which has attained a recognized commercial importance. The tree has no conspicuous faults; it begins to bear moderately early, usually producing considerably by the time it reaches 6 or 7 years of age; the crops are produced mainly in alternate years. The fruit when well grown is very attractive in appearance and is valuable for its keeping and shipping qualities, but is notoriously poor in dessert quality.

In general, it may be said that this variety is well adapted to the conditions in these regions, aside from those at the highest elevations, though there are some apparent exceptions to this, which are probably due to local influences. In the Georgia and South Carolina portions of the Piedmont region and extending to an elevation of perhaps 1,400 or 1,500 feet some excellent results have been obtained with it where the trees have been given moderately high culture and thoroughly sprayed. Fruit grown under these conditions, however, should be marketed by the holidays, as it may be expected to deteriorate rapidly if held later than this. Grown under conditions of neglect in the southern Piedmont, the fruit is likely to drop prematurely and often fails to color properly even when it remains on the trees until a comparatively late date. On the other hand, it is of interest to note that where it is grown in North Carolina at elevations exceeding about 3,000 feet the fruit develops characteristics similar to those which appear when it is grown in northern latitudes, the characteristics being quite different from those developed in sections to which the variety is well adapted. The elevations at which these characteristics become apparent naturally depends largely

upon the latitude, the high altitudes at southern points affording similar climatic conditions to lower altitudes in more northern sections. On Cecil clay at 800 to 1,000 feet altitude in the upper portion of the Piedmont region, the Ben Davis has generally given good results. Other types of soil common to the Piedmont region, such as Cecil loam, Cecil sandy loam, Murrill clay loam, and possibly some others, are probably less desirable types on which to grow this than Cecil clay. The latter and the types commonly found in the mountains within the altitude limits mentioned appear to give the most uniformly satisfactory results.

Bonum. Synonym: *Magnum Bonum.*

While this is one of the varieties which has been in cultivation many years and is quite widely distributed in these regions, it is seldom found except in the older orchards, and in these only in small lots. The tree is ordinarily a good grower and bears well, though quite largely in alternate years under usual conditions of culture. The merits of the fruit are such that as a September and October variety it is deserving of more general planting. While little or no effort has been made in these regions to develop a market for fall varieties, the high dessert quality of this one and its attractive dark red color, together with its medium size under favorable cultural conditions, would appear to make it a very desirable apple for supplying a fancy trade.

Very fine specimens are grown in Bedford County, Va., on Cecil clay, at an elevation of 1,000 feet. It does well at elevations of 800 to 1,000 feet on Cecil sandy loam in Albemarle County. In the upper Piedmont region, in Rappahannock County, Va., it is much prized, being marketed from the first of September to the middle of October, frequently at very satisfactory prices. The soil in the section referred to is a friable red clay loam, ranging in elevation from 1,000 to 1,500 feet. This apple is not well adapted to conditions prevailing at the higher elevations. On Porters black loam at 2,200 to 2,400 feet elevation the fruit is smaller than at lower points; in form and color it varies from the usual type, and its quality is relatively inferior. On a loose mountain soil in North Carolina at 4,000 feet altitude the quality of fruit from young trees is so inferior as to raise some question in regard to the identity of the variety. At another point on similar soil at about 3,000 feet it is said to do finely as a fall variety and bear regularly. In this instance it is thoroughly sprayed. This behavior, however, conflicts with the usual experience at the higher elevations.

Buckingham. Synonyms: *Fall Queen, Equinetely.*

This variety is not grown extensively in these regions and is seldom seen in orchards south of North Carolina. As a fall variety, it possesses fairly good dessert quality. It is usually productive and satisfactory on Cecil sandy loam and Cecil clay at 1,000 feet elevation; it is also considered valuable on Porters black loam at 1,200 feet. Very fine specimens have been found in some of the mountain orchards of western North Carolina on a friable clay loam with porous subsoil at an elevation of about 3,000 feet.

Buncombe. Synonym: *Red Winter Pearmain.*

This variety is in many of the older orchards, especially in the North Carolina portion of the regions under consideration. It is, however, of but little commercial importance and has rarely been included in the orchards of recent planting. Its season is late fall and early winter in the sections where it is most often found.

Cannon Pearmain. Synonyms: *Red Cannon, Green Cannon.*

The variety here named is peculiarly characteristic, in its distribution, of Bedford County, Va., seldom being found in any other section in these regions. It is of considerable importance in this county in the older orchards but has rarely been planted in the younger ones. Some growers claim there are two strains of the variety, one of which is designated as Red Cannon, the other Green Cannon. It is probable that these distinctions are only local with no constant differences between them. The tree attains large size and great age, frequently being found in good bearing condition at

from 75 to 100 years of age. The limbs are tough, not being easily broken by heavy crops of fruit or by storms. Under favorable conditions heavy crops may be expected in alternate years, with very light ones in "off" years. While the fruit is not of high dessert quality, it is considered by many growers to be the best "general-purpose" sort grown in this particular section, and it is prized for cooking, drying, and cider making as well as for dessert purposes. It usually sells well in southern markets, but is less desirable in the North than many other sorts. In certain instances it has proved very profitable.

In Bedford County, where it has been extensively studied, it is quite sensitive to the influence of the conditions under which it is grown. In general, it requires much the same conditions for its highest development that the Yellow Newtown apple does. These are described in considerable detail under that variety. A few specific facts regarding its adaptability may be mentioned. Porters clay at the higher points at which this soil type occurs gives good results; also Porters black loam at its usual elevations up to the limit of 2,500 feet at least. No observations have been made in the present connection at a higher altitude than this. In the Piedmont portion of this county it is rarely successful on the types of soil commonly found. Under these conditions the fruit rots and drops badly, and that which reaches maturity is usually small and inferior in appearance and flavor. Occasionally fairly good results are obtained from trees on Cecil clay and Cecil sandy loam, but such results are exceptional. Certain claims are made by some growers relative to the influence of soil upon the texture and color of the fruit, as, for instance, the development of a tougher flesh on the red clay soils than on other types. These claims, however, have not been verified.

Disharoon.

The distribution of this variety is very limited, even though it has been in cultivation for many years. The only specimens which have been found in connection with these investigations were grown in Habersham County, Ga., the county in which it originated. The fruit is only small to medium in size and not particularly attractive in appearance, but is of high dessert quality. It is therefore of value primarily for home use. In porous friable soils of the section mentioned, at an elevation of 1,200 to 1,500 feet, it does well.

Domine.

This variety is occasionally found in the older Piedmont orchards of Virginia, but it has not been planted in recent years. It does fairly well on all of the types of soil in the Piedmont region, but produces the most of its fruit in alternate years. In a high state of cultivation it would probably bear considerable fruit every year. In one orchard on Cecil sandy loam, at an elevation of about 900 feet, it is said never to fail to produce a partial crop. In this case it is receiving no special care. Its season of ripening is late fall and early winter.

Dula. Synonym: *Dula's Beauty.*

This variety is doubtless a seedling of the Limbertwig, as it originated from a collection of seeds of this variety which were planted for stocks. The general characteristics of the tree give additional evidence of such an origin. The tree, however, is more thrifty and vigorous than the Limbertwig. It originated at Lenoir, Caldwell County, N. C., from seed planted by Mr. J. A. Dula, who knows the variety as Dula's Beauty, but under the rules of the American Pomological Society this should be reduced to Dula. It has not yet been widely disseminated. It is a large, dark red, more or less striped apple of good dessert quality, keeps fairly well, and is a prolific bearer in the vicinity of its origin. It is considered an apple of much value as a long-keeping variety both for home use and for market, and is said to do well either on bottom land which is a sandy alluvial soil or on hills and ridges where the type approaches Cecil clay. The elevation where it is most grown is 1,000 to 1,200 feet.

Early Harvest. Synonyms: *Yellow Harvest, Prince's Yellow Harvest, Yellow Juneating.*

Of the early varieties this is more widely grown throughout the Piedmont region than any other sort. It is probably less frequently found in the Georgia portion of this region than in the other sections of it. It is used locally, however, and seldom shipped. No personal studies have been made; hence all data as to its behavior have been obtained through interviews with the growers. Elevations and soil types have been studied as for the later sorts.

It has been reported from Virginia growing at altitudes ranging from 800 to 1,600 feet and on nearly every type of soil common to these elevations in that State. It is being grown on many different types of soil at points south of Virginia, but it is confined generally to the elevations of the Piedmont region. It gives a high degree of satisfaction for its season from the middle of June at low elevations in the more southern latitudes to the middle of August or early in September at some of the highest points in North Carolina, where it occurs only rarely. In the middle Piedmont region its usual season is about July 10 to July 20.

Early Ripe.

Comparatively few growers in these regions are acquainted with this variety, but it is in a few of the Virginia orchards; it may rarely be found in other sections of the Piedmont region, but to a very limited extent.

The conditions under which it has been reported are essentially the same as those referred to under Early Harvest, and in the ideals of those who know the variety it fills much the same place that that variety does. In time of ripening it is about the same or a little earlier than Early Harvest. In certain important early apple-growing sections the Early Ripe is being planted extensively for commercial purposes.

Esopus. Synonym: *Esopus Spitzenburg.*

No important commercial plantings of this variety exist in these regions, but in very limited numbers trees of it may be found in a few widely separated orchards. Its value in most of these orchards is apparently very slight.

At the lower levels it usually drops prematurely, and even on Porters black loam at 2,000 feet elevation it often rots and drops seriously. At 3,000 to 3,500 feet altitude in North Carolina, on a rather loose loamy soil with porous subsoil containing more or less red clay, it develops more satisfactorily, keeps well into the winter, and does not manifest in any marked degree the defects observed at the lower levels. An apparent exception to the usual behavior of this variety is reported from Albemarle County, Va., at an elevation of about 1,000 feet and on what is probably Cecil clay soil. Under these conditions it is said to be unusually promising, as indicated by the behavior of a limited number of trees. The reported success of this variety in this location, however, is greater in the limited way in which it has been grown than experience elsewhere would have suggested as probable.

Fall Cheese.

This variety has been considerably confused in the Piedmont region, where it is more or less grown, with one or two other varieties. In some of the southern markets it is considerably sought after during its season, which in the middle Piedmont is September and early October. While apparently quite widely disseminated, it is not grown extensively and occurs rarely except in the old orchards.

The dessert quality of Fall Cheese is excellent, and for home use or for supplying certain trade demands it could doubtless be given more prominence than it has at the present time.

Fall Orange.

This variety is more often found in the older Piedmont orchards of the Virginia portion of these regions than at more southern points, but in this section its distribution is very limited. While not a heavy bearer, it is said to produce more or less fruit nearly every year. The fruit develops to a large size when well grown, acquires a rich yel-

low color, and possesses a pleasant flavor. For home use, especially, it would appear to possess considerable merit as a fall variety.

In Bedford County, Va., at 900 to 1,000 feet elevation on Cecil sandy loam, it has proved more satisfactory than most varieties have under these soil conditions. Here it reaches maturity the last of September, but may be kept until the holidays.

Fall Pippin.

This variety occurs in a few of the older orchards, particularly in Virginia, but it is unimportant in these regions. In the mountain orchards, where it is found, it generally bears good crops in alternate years, but in the Piedmont orchards it is apparently predisposed to decay and is of little value on this account. A difference of 500 feet in elevation makes considerable difference in the time of its reaching maturity. A similar difference is of course noticeable in the case of all varieties.

Fallawater. Synonym: *Tulpehocken.*

The distribution of the Fallawater apple is quite general in the Piedmont and Blue Ridge regions of Virginia in the older orchards, but it has rarely been planted in recent years, nor is it common south of Virginia. It is relatively unimportant here either for market or home use. The tree, though making a fairly vigorous growth, is short lived, twenty-five or thirty years being considered about the limit of time it may be expected to live. Fairly heavy crops are usually borne in alternate years.

Its behavior may be indicated as follows: At the lower levels of the Piedmont region in Virginia and along the foothills it reaches a very large size, and primarily on this account it drops badly. It is also subject to decay, almost the entire crop often being lost in this way. At elevations of 1,500 or 1,800 feet the fruit is generally smaller than at the lower levels and the dropping and other defects are less serious. At these higher points its season of maturity is late fall to early winter; in the Piedmont region it is a fall variety. In this connection it is of interest to note that in the northern fruit districts, where it is grown more or less, it can be held until well into the winter without difficulty. In a few instances trees on Cecil clay and Porters clay at an altitude of 1,200 feet have given good results, but as a rule the higher altitudes are to be preferred. In the northern portion of these regions trees on the red clay loams at altitudes of 1,000 to 1,500 feet formerly gave satisfactory results, but in recent years bitter-rot has been serious in this portion of the regions. This disease, however, can be controlled by proper spraying.

Gano.

The Gano apple is seldom found in these regions. From a limited observation it appears probable that it will correspond quite closely to the Ben Davis in its adaptability to conditions and in its general behavior in these regions.

Gilpin. Synonyms: *Carthouse, Romanite, Little Red Romanite.*

The Gilpin is a variety of minor importance, but is found occasionally in the older orchards. In localities where drainage is not perfect, both soil and atmospheric, it "clouds" badly. In locations in the middle Piedmont and Blue Ridge regions having elevations of 1,200 to 1,300 feet on Porters clay and Porters black loam it gives satisfactory results for the variety. It is an unusually long-keeping sort and is considered excellent for cider making.

Gravenstein.

The Gravenstein is a variety widely grown in many sections of the country, more especially in the North, but reported occasionally from Virginia and other southern points. While not fully tested in these regions, it is promising for its season, which in the central Piedmont region is during August. It is of value for cooking and for dessert and is one of the comparatively early sorts that is desirable for evaporating.

Grimes. Synonym: *Grimes Golden.*

The occurrence of this variety is quite general throughout these regions, and though not as yet grown extensively in many of the orchards, it is of recognized commercial

value, the importance of which is undoubtedly increasing. The tree is considered by fruit growers generally to be short lived, but no particular complaints of this kind have been noted by the growers here. However, most of the trees are still comparatively young. The tree is satisfactorily productive as a rule, though under the usual cultural conditions it has "off" years, as do most varieties.

Experience thus far indicates that the Grimes is a desirable variety to grow both for home use and commercial purposes in most of the Piedmont and Blue Ridge regions where conditions are suitable for the planting of apple orchards. The relative elevation appears to be a particularly important factor in its effect upon the durability of the fruit. Reference to its behavior at particular points will indicate the influence of conditions upon it. An orchard 12 to 15 years old in Bedford County, Va., on Porters clay, at 1,500 feet elevation with southeast exposure, produces fruit of unusual excellence, notable for its good size, fine yellow color, crispness of texture, and rich, spicy flavor. This orchard has had hardly fair care. The fruit of this variety from it reaches edible maturity early in October, but possesses good keeping qualities for the variety. On the same farm at a point having somewhat lower elevation and a looser type of soil it matures considerably earlier and is not of such excellent flavor as from the location above mentioned. Produced at elevations of 2,000 feet in the upper sections of the Blue Ridge region it may be kept under fairly favorable conditions until early winter. Grown on Cecil clay at 1,000 feet elevation it lacks the rich color and high flavor mentioned above, the size is somewhat smaller, yet this combination of conditions appears to meet the requirements of the variety fairly well. In certain sections on Murrill clay loam the fruit appears to be susceptible to certain fungous diseases, especially the so-called "cloud" or "sooty" fungus. But the location with reference to air drainage may account for this. At points south of Virginia at the elevations of the Piedmont region it is inclined to drop prematurely, but when grown at points having not less than 1,500 feet altitude it is highly prized in its season. One grower in the southwestern part of North Carolina has this variety at 2,500 to 2,800 feet elevation, and also at an altitude 400 to 600 feet higher. It is his experience that the fruit grown at the latter elevation will keep two months longer than that from the lower level. The fruit is also finer in appearance and more satisfactory in every way at the greater elevation. For best keeping qualities it should not be allowed to become too mature before picking.

Hoover. Synonym: *Black Coal.*

In the Virginia and North Carolina portions of the mountain region the Hoover is widely distributed, though mostly in small plantings, but it is not grown extensively in the Piedmont region. The orchards in South Carolina and Georgia seldom contain it. In the Virginia section it is usually found at the higher altitudes growing on Porters black loam. Under these conditions the color becomes very dark and glossy, often almost black; at lower levels it is somewhat dull in color and rather unattractive in appearance. Its season of maturity is late fall, but fruit from the orchards of greatest elevation may be kept until early winter. In North Carolina the conditions under which the variety is grown have not been as carefully studied as in Virginia, but in passing through the mountain sections one sees this variety very commonly. During the fall it is the one most often brought to the stations for sale to passengers on the trains.

Jonathan.

This variety occurs only rarely, and reference is here made to it because of the possible value it may possess for these regions. The tree is not always as vigorous as might be desired, but usually no serious difficulty exists in this respect. Fairly early bearing is a characteristic. Normally its season is late fall to early winter, but if grown at moderately high elevations it would probably reach maturity sufficiently late to permit of its being handled in cold storage, for which it is especially well adapted. It

possesses exceptionally high dessert quality and ranks as an important commercial variety in some sections of the country.

Its behavior in the few places in these sections where it is known to occur indicates that it is worthy of careful consideration by those who are planting orchards at elevations of 1,200 to 1,500 feet or more within these regions. The finest specimens found in these regions have come from the orchards which have the highest altitudes of any of those in the Blue Ridge. Observations have been confined to young trees.

Kinnard. Synonym: *Kinnard's Choice.*

This variety occurs at a few rather widely separated points in these regions, but the plantings of it are small, in most cases consisting of only a few trees. There appears to be no well-defined reason, however, why it has not been more generally planted than has been the case. Its good size, attractive, dark red color, and pleasing dessert quality are all factors in its favor, and so far as observed the tree appears to be productive and desirable in its habit of growth. Its season is late fall and early winter, but with proper handling it possesses fairly good keeping qualities. It is more nearly an annual bearer than most varieties.

The soil types and elevations where the Kinnard apple has been studied are the following: In Virginia, Amherst County, Porters clay, at 1,200 to 1,500 feet elevation; Bedford County, the same, also on Murrill clay loam at 1,000 feet. In Lumpkin County, Ga., in a sandy loam with rather loose porous subsoil, at 1,500 feet elevation; in Habersham County, under conditions very similar to those mentioned in Lumpkin County, also at about 1,700 feet altitude on a very friable, deep red loam with porous subsoil having a small content of clay. Under this range of conditions it has been uniformly successful and experience thus far warrants the conclusion that it is one of the most valuable varieties with fairly long-keeping qualities for growing at southern points.

Kittageskee.

In the southern portion of the Piedmont region it is said that the Kittageskee variety is one of the surest bearers of any with good keeping qualities. No personal observations have been made. The fruit is small, but its bearing proclivities commend it especially for home use. The soil in this portion of the Piedmont region is mostly a friable red clay or sandy loam, with elevations ranging from 1,000 to 1,500 feet.

Lawver. Synonym: *Delaware Red Winter.*

There are but few places in the eastern portion of the country where this late-keeping variety is grown extensively, yet it is widely distributed. It is of very slight importance in the estimation of nearly all who have had experience with it. It has been found at one point in the southwestern part of North Carolina at about 3,000 feet elevation, and also in northeastern Georgia. It is of no special value in either section, though it is said to bear well in North Carolina, which is quite contrary to its usual behavior in this respect in most sections where it is grown.

Limbertwig. Synonyms: *Red Limbertwig, Green Limbertwig.*

This is another one of the well-known varieties which was widely planted in the older orchards throughout the entire Piedmont region and to a lesser extent in the mountains, but it has seldom been planted in recent years. It is generally considered a standard winter variety in these regions, though not an important commercial sort. In some localities, especially certain ones in North Carolina, it is the only variety grown in any considerable quantity. The main axis of the tree is rather upright in habit of growth, but the smaller branches are considerably drooping. It is more regular in bearing than many varieties are. The fruit is seldom above medium size; color, as frequently grown, is a dull, unattractive red, but under the most favorable conditions it becomes a clear, deep red. In some seasons it has been quite susceptible to bitter-rot.

Its behavior may be outlined, as follows: Grown on Cecil sandy loam at 800 feet in the Virginia section, it is inclined to rot and drop even when given fairly good care. Cecil loam at corresponding elevations gives somewhat better results. With good care this apple reaches a rather high degree of perfection in the upper Piedmont and Blue Ridge regions on Cecil clay, Porters sandy loam, and Porters black loam at elevations of 1,000 to 1,300 feet; likewise, it generally does well on the clay loam soils of the Piedmont region in North and South Carolina and northeast Georgia. At the higher points in North Carolina conflicting results occur frequently. For instance, on a soil similar to Cecil sandy loam at 2,000 feet altitude, one grower claims that this variety possesses more good qualities and is more satisfactory than any other variety. Another one not far distant from the first considers it unsatisfactory in every way. It is quite possible in this particular instance that the question of soil moisture is the determining factor, the moister soil giving the better results. Again, on clay loam soils at 3,000 to 3,500 feet elevation the behavior is satisfactory, the fruit being much more juicy and larger and finer in every particular than it is under many other conditions. On the other hand, there are instances under nearly all of these conditions in which the rotting and dropping of the fruit are serious faults. Such results render impossible any general summary regarding its limits of adaptability.

McAfee.

So far as observed, this variety has not been planted intentionally in any portion of these regions, but in several instances it has been obtained through error and is being grown under some other name, usually the one for which it was bought. In the few places where this variety has been observed, however, it appears to grow and fruit well. It is an apple of fair size, prolific, and as a rule of excellent keeping qualities, often producing fruit when most other varieties fail. Its rather dull color makes it less desirable as a market sort than many others, and for this reason especially it is doubtful if it is likely to become of any particular importance in this region.

It does well, as noted, in the case of young trees on Cecil clay at 800 feet elevation. On Cecil sandy loam at 1,000 feet, where most varieties are at best of uncertain value, this is a fairly good winter sort, and at 1,500 feet on a loose, blackish sandy loam, which is a deposit washed from a Porters clay hillside and doubtless underlaid by this type, it is giving good results so far as its fruiting capacity is concerned. It bears more or less every year, and the specimens are very fine of the variety. Also at about the same elevation in North Carolina on a sandy loam soil with porous subsoil it is giving favorable results. Similar results are obtained in corresponding locations in northeastern Georgia.

Maiden Blush.

This is not a prominent variety in these regions and has been mentioned only occasionally, but most of the reports concerning it are favorable. On Cecil sandy loam at 900 to 1,000 feet elevation it is inclined to rot severely, but on the more clayey soils of the Piedmont region it does well. Its season of ripening varies considerably, ranging from summer to early fall. In the middle Piedmont orchards it would probably ripen in August or early in September; at one point in North Carolina having an altitude of 3,500 to 4,000 feet, with rather loose friable loam, some very fine specimens have been seen the middle of October. In some sections of the country where early apples are grown extensively this is an important commercial sort.

Milam.

Comparatively few growers have this variety in their orchards. Its small size restricts its usefulness to the home orchard, but its high dessert quality makes it of value in this connection. It may be used in the fall, yet under favorable conditions it can be kept until well into the winter. Cecil sandy loam at 1,000 feet altitude and Porters clay at 1,500 feet appear to be favorable soil conditions for its growth in the Virginia portions of these regions.

Missouri. Synonym: *Missouri Pippin.*

This variety is found only occasionally in the younger orchards. It has not been tested sufficiently to render definite conclusions possible as to its merits for these regions. The tree is quite susceptible to twig-blight in some places. In fact, this is a rather serious weakness of the tree. Blight has been noted on trees growing on several types of soil in these regions, but it is doubtful if this is associated directly with the soil conditions. It comes into bearing at an early age, and for this reason it is frequently recommended as a "filler" to plant with other sorts with the intention of cutting it out when the permanent trees require the space.

As to the adaptability of the Missouri apple, it is sufficient to state that on Cecil clay and Porters clay at 1,000 to 1,200 feet, it is promising as a commercial sort. It has fairly good keeping qualities. At 3,000 feet in North Carolina it is doing well, but at the higher points it is of doubtful value.

Nansemond. Synonym: *Nansemond Beauty.*

This variety is quite widely distributed, but it is so very poor in dessert quality that it is not a popular apple, though it is frequently very beautiful in appearance and sometimes sells at good prices.

The finest specimens of this variety which have come within the range of these studies were grown in southern Virginia at an elevation of from 1,200 to 1,500 feet, on a soil approaching Porters sandy loam, but containing more clay than this type does, and on an eastern to southeastern slope. The trees were 16 to 18 years of age. Under these conditions it is very highly colored and of good size. Cecil clay and Cecil sandy loam at the usual elevations of these types produce fairly good specimens, but the color is usually less brilliant and the tendency to "cloud" much greater than at the higher points referred to. The tendency to drop its fruit badly is noticeable under a wide range of conditions. This difficulty has been noted especially in Virginia on Cecil clay at 1,000 feet and on Porters black loam at about 2,200 feet.

Nickajack.

In these regions this variety is commonly known by the name indicated, though more than forty synonyms for it have appeared in American pomological literature. It has been quite widely planted in these regions, especially in the Piedmont, though in small quantities. It is generally successful, being more regular in bearing than many varieties are. The fruit is similar in general appearance to McAfee, and in these regions it is doubtless preferable to that variety. In the upper portion of the Piedmont region, grown on Cecil sandy loam, Cecil clay, or Porters clay at the usual elevations of those types, it is generally prolific. The fruit may be kept until well into the winter without special care.

Northern Spy. Synonym: *Spy.*

The Northern Spy is another one of the northern varieties which is found frequently in the older orchards of these regions and is widely distributed throughout them, especially in Virginia and North Carolina, though occurring in small numbers. It has been found on nearly all the more common types of soil and at many elevations from 1,000 to 3,500 feet. While it is a standard winter variety in the North and of high dessert quality, it is of little or no value here, except possibly at the highest elevations. The claim is made that it lacks the peculiar crispness and richness of flavor in the South which characterize it in the North. The tree is a vigorous grower, and under favorable conditions it reaches large size, but it is very tardy in coming into bearing. It is frequently planted in some sections of the country as a stock on which to top-work other varieties.

Serious rotting and dropping are conspicuous faults at most southern points where this variety is grown, except at the highest altitudes. The longest keeping specimens and those which in every way approach most nearly to the best type grown in the North are produced at elevations of 3,500 to 3,800 feet in North Carolina on clay loam

soil with porous clayey subsoil. Such conditions develop a firm, solid fruit, with excellent color and fair keeping qualities. Porters black loam and some modifications of it at 2,000 feet or more in Virginia also produce good fruit, but the natural limit of its durability is reached by the Christmas holidays or early winter. So far as observed there is no exception to the general statement that at points below 1,800 or 2,000 feet elevation the variety is unsatisfactory, premature rotting and dropping occurring to a disastrous extent.

Oldenburg. Synonym: *Duchess of Oldenburg.*

As with Wealthy, Gravenstein, and several other varieties considered in this connection, but little is actually known of the behavior of this sort in these regions. So far as reported it is a regular and abundant bearer and gives promise of value as an early ripening variety for culinary purposes. Its season in the middle Piedmont would probably be early July.

Ortley. Synonym: *White Bellflower.*

Only a passing mention of this variety is required, as it is of little importance. It is in a few of the older orchards, where very little attention is given to it. Loamy soils with deep, rich, porous subsoil and comparatively high altitudes are favorable to its best development. It has a long ripening season and may be used throughout the fall months.

Pennock. Synonyms: *Pennocks, Red Pennock, Phœnix, Winter Penick, Large Romanite.*

It is seldom that this variety is found at the lower altitudes away from the mountains, but it is common in the foothills and higher elevations.

A dry rot or breaking down of the cell tissue just under the skin has been observed in certain instances, especially in the Georgia section. This variety is of only secondary importance. It does not have a reputation for heavy crops, but on Porters black loam from 2,000 to 2,500 feet elevation the fruit develops very finely and may be kept until well into the winter. The red clay loams at 1,000 to 1,200 feet also give good results where located at the foot of the mountains.

Pilot. Synonym: *Virginia Pilot.*

Like the Pennock, the Pilot is not often found, except in the mountains or in close proximity to them. It has seldom been planted in recent years. The tree requires an unusual amount of room for best results, since it grows to a large size. It is very late in coming into bearing, little fruit is produced before the trees are 12 years old, and frequently they are nearly 20 before they become a source of much profit.

This variety seldom gives satisfaction below an altitude of 1,200 feet, and then only on Porters black loam or some of the other rich, loose, mountain types of soil. On Porters clay at 1,600 feet it usually produces light crops, which frequently decay. In some places it hardly bears at all, particularly on the heavier clay soils at less than 1,000 feet elevation, where it occasionally occurs. The fruit often sets under such conditions, but it drops badly and is also liable to decay. The trees which have made the best record of any observed are in a Virginia orchard on Porters black loam with a western exposure and an elevation of not less than 1,500 feet. These trees are probably twenty years old and bear considerable fruit nearly every year. Annual bearing, however, is unusual with this variety. Some of the small growers in the mountain sections sometimes allow the fruit to remain in piles all winter under the trees, covering them with a light mulch of leaves or straw. In the spring, after the frost has gradually withdrawn before the mulch is removed, the fruit is barreled and sold. It is claimed that very satisfactory prices are often obtained when handled in this way.

Pine Stump.

But little attention has been given this variety by any of the growers. It is of North Carolina origin and has been propagated more or less by some of the nursery-

men of that State. The tree makes a fairly strong, healthy growth and is nearly an annual bearer. It does not reach a sufficiently large size to be desirable when grown in the mountains. For home use and local markets during the fall, if grown under favorable conditions, it is worthy of more consideration than it has yet received.

Pryor. Synonyms: *Pryor's Red, Big Hill.*

Many of the older orchards contain this variety, but it is more commonly known by its synonym Big Hill. It has been studied under quite varied conditions of soil and elevation, but there seems to be very little to recommend it for any portion of these regions. It is irregular and unreliable in bearing and more susceptible to diseases such as "cedar rust" and "leaf spot" than most varieties are. The fruit, when a crop is produced, is considered of pleasing dessert quality for early winter use. It is commonly said to be "played out."

Rabun.[a] Synonym: *Rabun Bald.*

This variety has not yet been disseminated outside of the locality of its origin in Rabun County, Ga., but on account of its apparent value as a winter sort of good dessert quality for the southern Piedmont and Blue Ridge regions it is referred to in the present connection. In the locality where it was first discovered, the tree is a stocky, vigorous grower, producing a heavy crop in alternate years, with considerable fruit in "off" years. The fruit is large; under color, yellow, but when well colored heavily splashed and striped with bright crimson; good to very good in dessert quality.

Ralls. Synonyms: *Rawles Genet, Geneton, Janet, Neverfail.*

Over thirty synonyms of this variety exist in American pomological literature, of which those given are the ones in common usage. There are few varieties of apples so widely distributed in as many different sections of the country as this one is, though it is seldom found in orchards of recent planting in these regions. The tree does not develop to a large size here, but is more nearly an annual bearer than most varieties are and often produces such heavy crops that the fruit is abnormally small. On account of blossoming very late it may escape injury from unseasonable frosts in the spring when most varieties are damaged thereby. It is one of the longest keeping varieties grown in these regions. It is very variable in its behavior from year to year, even on the same trees; especially is this true with reference to bitter-rot. In 1902 it was seriously affected by this disease in a large proportion of the orchards in these regions, regardless of soil or location, while in 1903 it was comparatively free from fungous diseases of all kinds, notwithstanding the fact that many varieties were more seriously attacked by bitter-rot than in the previous year.

In its wide distribution in these regions, it is found growing under nearly all combinations of conditions characteristic of them. As before noted, its difference in behavior from year to year makes reliable deductions difficult. From data at hand, however, it appears that Porters black loam and Porters clay at the higher altitudes, where so much of the finest fruit is grown, are no more favorable locations for it than Cecil clay at lower elevations. One of the most unsatisfactory impressions of the variety comes from an orchard at 1,500 or 1,600 feet elevation on Porters clay. Murrill clay loam and Cecil clay usually produce as good results as any soil conditions which exist in these regions. In the orchards of greatest elevation in North Carolina the fruit sometimes fails to develop properly, but remains green, and the texture is tough and hard. On the other hand, in 1904 some trees at these high altitudes produced a good crop of very excellent fruit. As the climatic conditions were the one variable factor, the only conclusion which seems possible is that these differences in the behavior of the variety in this instance were due to the climatic differences of the seasons.

[a] For more complete history and description see Yearbook, Department of Agriculture, 1906, p. 359.

Rebel.

Although unimportant commercially at the present time in these regions and grown only sparingly in a few orchards, the fine appearance and good dessert quality of the Rebel apple make it worthy of more general testing than it has yet received. In season it is late fall and early winter.

In the middle Piedmont region on Cecil clay it does well and is apparently of value. It is less successful generally when grown on the red clay loams as far north as Rappahannock County, Va., than it is farther south. At some points in the Shenandoah Valley (which is, of course, outside the limits of the regions in question) the fruit as a rule is rather undersized.

Red Astrachan.

The Red Astrachan is not important in these regions at the present time, but in some sections where early apple growing is a commercial industry it is one of the most profitable varieties grown. It is known to possess a wide range of adaptability in many different sections of the country, and from available data at hand it seems probable that it may be of value in large portions of these regions for its season, which in most of the Piedmont region is during July. Possibly it would begin to ripen at extreme southern points late in June. The range of conditions, however, from which actual data have been obtained have been rather limited. The tree as a rule makes a strong growth. It is late in coming into bearing, often being 10 to 12 years old before it bears heavily.

At 1,000 to 1,300 feet elevation on Cecil sandy loam and on Cecil clay in Virginia satisfactory results are claimed. Similar favorable reports are given in the South Carolina section of the Piedmont, where this variety is more or less grown. It has seldom been found at the higher altitudes; hence, its behavior in the more elevated places and under the soil conditions of the mountains can not be definitely stated. At one point in North Carolina on soil similar to Cecil sandy loam, at about 2,000 feet elevation, it is said to develop a slightly bitter taste, which makes it unpopular, but aside from this it is said to do well under these conditions.

Red June. Synonyms: *Carolina Red June*, *North Carolina Red June*, *June*.

The distribution of this variety in the Piedmont region is quite wide, though the individual plantings are small. It is one of the earliest ripening varieties grown in the region, and is considered of value for its season. In general, the comments relative to Red Astrachan are applicable to this variety also. At points in the extreme southern portion of these regions it is grown more commonly than the Red Astrachan is. On the sandy loam of Lumpkin County, Ga., with an elevation of 1,500 feet, it is said to do especially well.

Rhode Island Greening. Synonym: *Greening*.

As might naturally be expected, this variety is of but little value here under any of the existing conditions. It follows closely the behavior of most northern varieties when grown at southern points. Fortunately, it is in only a few orchards. The most satisfactory location observed is in western North Carolina, at an elevation of 3,000 feet, on a deep porous loam. Under most conditions in these regions where it has been found, early maturity, premature dropping, and decaying are common faults. In most southern locations, except at high altitudes, it lacks nearly all the points of merit which in the northern fruit-growing regions make it one of the standard commercial winter sorts.

Rome Beauty. Synonym: *Gillett's Seedling*.

Although this is a well-known variety and one widely distributed, it is rarely found in the regions in question. As a rule, wherever it has been planted it is growing under some other name, and only a tree or two of it in a place. Most of the trees in this region are young; hence, the variety has not been tested for a sufficient length of time to definitely determine its merits. It appears, however, to be promising for

this section, especially in the Blue Ridge region, and to be worthy of attention by those who are planting orchards or even small collections for home use.

In Virginia, on Cecil sandy loam, at 900 feet, it is especially satisfactory, particularly in view of the fact that these conditions are unfavorable to most varieties. So grown, it is said to keep until the holidays. Cecil clay and Porters clay at elevations of 1,000 to 1,500 feet, in the northern Piedmont and Blue Ridge regions, usually combine conditions which are favorable to this variety. At 1,500 feet altitude on Porters clay it becomes an early winter variety of very fine appearance and good dessert quality. As a rule, it is considered especially well adapted to sandy soil. On Porters black loam at 2,300 feet, it is considered of more than usual value. It is highly prized in western North Carolina, where it occurs at an altitude of 3,000 feet on a deep porous mountain loam. It is, however, somewhat inclined to drop. This is its greatest weakness, but with good cultural conditions it appears worthy of more general planting in the future.

Roxbury. Synonym: *Roxbury Russet.*

While grown considerably in the northern fruit districts, the Roxbury is an unimportant sort in the South and is in only the older orchards. It produces fairly abundant crops in the mountain orchards, and the fruit usually reaches a comparatively high degree of perfection for the variety, but it lacks the long-keeping qualities for which it is especially valued in the North.

Shockley.

This is another one of the widely distributed varieties of the older plantings. It possesses many characteristics of merit in nearly the entire Piedmont region from Virginia to Georgia. Its small size makes it undesirable for commercial purposes, and its poor dessert quality renders it unfit for a high-class dessert apple, but its abundant and regular bearing proclivities under most Piedmont conditions and its unusually good keeping qualities make it worthy of some consideration, even though it is lacking in some other particulars. Doubtless the conditions under which it grows influence its flavor to a noticeable degree. The claim has been made in one comparison that on Porters black loam with northern exposure it is small and of very poor flavor, while at the same elevation on a red clay soil with southern exposure it is of good size for the variety and its flavor greatly improved over that on Porters black loam. In some instances the fruit has been severely attacked by apple scab and cedar rust, especially the latter. This susceptibility to disease does not appear to be influenced by location.

At 1,500 feet altitude in Albemarle County, Va., on Porters clay, this variety is not considered of special value, but at the same elevation in Georgia on a soil containing rather more sand than Porters clay does, with good culture it comes to a high degree of perfection, and when held until midwinter it generally brings very satisfactory prices in local markets. In the southwestern part of North Carolina, at 1,700 feet elevation, on a friable, porous loam, with good culture it bears annual crops of highly colored fruits, which develop to a larger size than under most conditions. In North Carolina at 3,500 to 3,800 feet, while the Shockley apple bears heavily and colors well, it is usually too small to be of much value, especially as other more desirable sorts succeed at these elevations. The clay and clay loam soils of the Piedmont region with the usual elevations of those soils may be expected, as a rule, to produce this variety in a fair degree of perfection.

Smith Cider.

In a number of orchards at widely separated points in these regions, the Smith Cider apple is grown more or less. While it does not rank high as a commercial sort it has frequently been a profitable variety. The fruit is more subject to bitter-rot than many sorts are, but this disease has not been very serious as a rule. Its season is late fall or early winter, depending upon the conditions under which it is grown.

On the Cecil clay and Porters clay soils of the Piedmont region of Virginia this variety usually reaches good size, colors well, and develops a higher dessert quality than it does in many sections of the country. It also does well in the mountains up to an elevation of 1,500 feet. It has been found in only one or two orchards at higher elevations, but at these points it is of no special value, since it appears to lack the characteristics which make it desirable at the lower levels. At an altitude of 3,000 feet on loose mountain soil in North Carolina it is said to bear irregularly, to be of soft texture, and to possess poor keeping qualities. In the northern portion of the Piedmont region when grown on the friable red clay loam at about 1,500 feet altitude it is especially mentioned for its productiveness and is said to be a profitable market variety.

Smokehouse.

A large number of orchards contain this variety in both the Piedmont and Blue Ridge regions, although it seldom occurs in their southern portion. It is valued both for market and for the home orchard. Fairly heavy crops are borne in alternate years, with very light crops as a rule in "off" years. In the central Piedmont sections it is a fall apple.

That it may be successfully grown under a wide range of conditions is made evident by the universally favorable reports made by growers whether located on the clayey soils of the Piedmont or the more porous types of high mountain sites.

Stayman Winesap.

The plantings of this variety have been very limited and of too recent date to draw any definite conclusions as to its ultimate value for these regions. It is generally considered one of the more promising of the newer sorts. In North Carolina at 3,000 feet elevation it is considered of special value, and at one point extensive plantings of it have been made. While in some seasons it does not color as highly as is desirable, this defect apparently occurs less frequently as the trees get older. At an elevation of 3,500 to 3,800 feet in North Carolina on loose mountain loam young trees have produced exceptionally fine specimens. So far as observed it is also promising under Piedmont conditions.

Summer Rambo.

There has been a lack of systematic study of this variety, as of all the earlier ripening sorts. It is a common variety in some sections of the Piedmont regions and gives general satisfaction for its season. It is not much grown in the mountains.

Terry.[a] Synonym: *Terry Winter.*

The dissemination of the Terry apple has been somewhat general through the extreme South, but in very limited numbers. The tree is a slender, upright grower and very productive, the fruit inclined to be undersized on this account. Nearly annual crops are produced. It is one of the few late-keeping, well-colored winter sorts of high dessert quality which are especially adapted to southern conditions.

The only orchard in these regions in which trees of this variety have been located is in Habersham County, northeastern Georgia. At this point the elevation is about 1,400 feet and the soil a reddish, rather sandy loam characteristic of this region. Under these conditions, with good culture it is proving of exceptional merit as a winter sort. The many points of merit which it possesses make it one of the most promising varieties for the southern portions of these regions.

Tompkins King. Synonyms: *King, King of Tompkins County.*

It is sufficient to note concerning this variety that it follows in general the behavior of the other northern varieties which have been planted in the South. It is not much grown, however, in these regions. The tree is short lived here, as in the North.

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[a] For a more complete history and description, see Yearbook, Department of Agriculture, 1903, p. 270.

In the upper portion of the Blue Ridge region at an elevation of 1,500 feet on Porters clay it matures early in the fall, possessing no particular points of merit. In some of the orchards of greatest elevation in the Blue Ridge it more nearly reaches the characteristics of northern grown specimens, but it can not be recommended even for these locations.

Virginia Beauty.[a]

The history of this variety dates back nearly a century to its origin in Carroll County, Va. Though more or less disseminated in that section of the State soon after the original tree began to bear, it does not appear to have become generally known, unless possibly in a few particular sections, until comparatively recent years. This variety has been planted quite extensively in some sections of these regions during the past few years. The tree is a sturdy, stocky grower with branches standing out nearly straight from the main axis of the tree, producing a rather flat head. In a few instances it has blighted somewhat, but this has not been a common experience. The fruit is large; when highly colored nearly a solid purplish red; flavor mild, subacid, almost sweet, and of excellent dessert quality. Its season is fall to midwinter, as influenced by the conditions under which it is grown and kept. It is fairly productive, though possibly not bearing such heavy crops as some sorts.

This variety has been noted as giving very pleasing results on Cecil clay and Cecil sandy loam at 800 to 1,200 feet elevation, and at the higher elevations in western North Carolina it is also doing well. The influence of elevation does not appear to be as marked as in the case of many other varieties which have been mentioned.

Wealthy.

This variety is rarely found in these regions and the trees are of too recent planting for it to be fully tested yet. From the indications, however, it appears to be a promising variety for its season. Its behavior in other widely separated sections indicates that it is well adapted to an extensive range of conditions. It is attractive in appearance, of good dessert quality, suitable for either home use or market, ripening in the central Piedmont region of Virginia during August.

Willow. Synonym: *Willow Twig.*

The limited range of conditions under which this variety has been studied renders a definite estimate of value impossible. It has been located in a small number of orchards, of which the following represent typical conditions.

At one point in Bedford County, Va., on what is probably Porters sandy loam with east to southeast exposure and 1,200 to 1,500 feet elevation, this is considered one of the most satisfactory varieties. It also does well on the porous mountain soil of North Carolina at 3,600 to 3,800 feet altitude.

Winesap.

This is one of the four or five great commercial varieties of the Piedmont region, and as a "general-purpose" winter apple for the Piedmont conditions it is one of the most uniformly successful and satisfactory sorts grown in this region. What the Baldwin is to the northern apple-growing sections, this variety is to this region. In habit of growth the tree is somewhat drooping and irregular, but it is fairly strong and vigorous, though occasionally severely attacked by some of the leaf-blight fungi. The root system is inclined to be rather weak and shallow; hence the trees are more liable to be uprooted during storms than they otherwise would be, but in orchards that are fairly well protected this has not proved an especially serious matter. The trees often begin bearing when they are 3 or 4 years old and usually produce paying crops when 6 to 8 years old. While not producing heavy crops every year, they are more nearly annual than those of most varieties, especially when the trees are maintained under good cultural conditions.

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[a] For a more complete history and description, see Yearbook, Department of Agriculture, 1905, p. 495.

Reference to its behavior under stated conditions will indicate in some degree the range of adaptability of the Winesap in these regions. At 800 to 1,000 feet altitude on Cecil sandy loam in the upper Piedmont the tendency to rot and drop is more marked than on Cecil clay at the same altitudes. This is, however, one of the most satisfactory winter varieties on Cecil sandy loam at the usual altitudes of this soil. Cecil clay and Porters clay at elevations of 1,000 to 1,200 feet furnish combinations of conditions which appear to be quite ideal for producing this variety with marked success. As a rule, orchards thus located may be expected to be more regular in bearing and to produce finer, more highly colored fruit than under most other conditions afforded in these regions. On Porters black loam and the other loose mountain soils at elevations exceeding 1,200 to 1,500 feet it is susceptible to the apple scab fungus, and increasingly so at higher altitudes. At the higher elevations it is also usually small and poorly flavored and frequently possesses a faded, "washed-out" color which appears to be peculiar to such conditions, with a tendency to stripe instead of developing a solid red color. These tendencies have been noted in a lesser degree in some of the "cove orchards" at elevations of less than 1,200 feet, where Porters black loam abounds, but they are much less pronounced and occur with less uniformity than at the higher points. On the other hand, extended observation indicates that these characteristics tend to disappear on red clay soils until elevations of at least 1,500 feet are reached, and possibly even higher altitudes. The effect of the higher elevations, as above noted, appears to diminish to a large extent in the rather loose clayey loam of the Blue Ridge region in western North Carolina. The soil in question is intermediate in physical characters between Cecil clay of the lower levels and Porters black loam. With these soil conditions at elevations of from 2,500 to 2,800 feet, the Winesap is considered one of the standard commercial winter varieties. It is said, however, to bear more abundantly on the heavier clay soil which is found in small areas in this mountain section than on the more loamy types. The conditions in the northern portion of the Piedmont region seem to be less uniformly favorable to its highest development than in most of this region, the fruit developing some of the characteristics of that grown at the higher elevations farther south. In connection with the behavior of this variety in these regions it is of interest to note that the peculiarities which it develops in the northern portion of the Piedmont region and at high elevations farther south in the Blue Ridge are similar to those manifested in the northern apple-growing districts, but in the North they are still more pronounced than they are at any point in the South.

Summarizing these results, it is apparent that the conditions in the northern portion of the Piedmont region at 1,000 to 1,200 feet elevation do not produce the best results, and that in the more southern counties of Virginia which have been referred to the conditions produce very excellent fruit, but less satisfactory results are secured at points having elevations which much exceed that of the Piedmont region, while still farther south this variety can be grown at higher altitudes than is possible in the northern portion of the Piedmont. Its behavior thus indicates in an interesting way the corresponding relationship between altitude and latitude in their influence upon the behavior of this variety.

Winter Paradise. Synonym: *Paradise Winter Sweet.*

There are few sweet apples grown in these regions, and of the number this is the most common one, especially in the older orchards of the Piedmont section of Virginia. It is not being planted much at the present time. Its season is fall and early winter. By careful handling it can be kept until the Christmas holidays. As a local market variety it is fairly popular, usually bringing as high prices as any variety of its season, and frequently more than most sorts. The fruit is more or less subject to bitter-rot, the loss from it sometimes representing a large part of the crop.

From observations made thus far it is apparent that the best results may be expected on Porters clay at elevations of 1,200 to 1,500 feet in the middle sections of these regions or in corresponding locations north and south. Wherever it has been found at the higher altitudes in Virginia on the loose mountain soils, the fruit has usually been rather small in size and of poorer dessert quality than at the lower points.

Yates. Synonyms: *Yates Winter*, *Red Warrior*.

The Yates is a variety widely distributed over much of the Piedmont region, though seldom grown in commercial quantities except for small local markets. The tree makes a healthy, thrifty growth, bearing regular and heavy crops. The fruit is small in size, rather unattractive in appearance, and not of high dessert quality, but even when grown in the extreme southern portion of these regions it has long-keeping qualities, frequently being kept until spring with no special care, and then, when there is little competition with other varieties, it is sold in local markets at very profitable prices. For general market purposes, however, its small size makes it undesirable.

In the course of these studies this variety has been found doing especially well on Cecil sandy loam in Bedford County, Va., at about 1,000 feet elevation and in northeast Georgia under the conditions mentioned under Terry. Its productiveness and long-keeping qualities in these sections make it considerably prized.

Yellow Bellflower. Synonym: *Bellflower*.

This variety has been found in several orchards under quite widely different conditions in the Virginia section of these regions, including both lowland and mountain locations. There is nothing to recommend it in any of these situations so far as observed. As a rule it is unproductive, and the fruit which reaches maturity is relatively small and inferior in nearly every particular.

Yellow Newtown. Synonyms: *Albemarle Pippin*, *Newtown Pippin*, *New York Pippin*, *Virginia Pippin*.

In these regions the synonym first mentioned is the name by which this variety is universally known, though the leading varietal name, according to the rules of the American Pomological Society, is as indicated. It is one of the few prominent commercial varieties of these regions, Winesap, York Imperial, and Ben Davis being the others of most importance. It is grown to some extent the entire length of the Blue Ridge region, but more extensively in Virginia and North Carolina than at points farther south. While it ranks as one of the leading commercial sorts of these regions and doubtless bears a more flattering reputation than any other one, there are comparatively few growers who consider it as profitable as some of the other varieties, and it is being planted extensively at present only in a few rather restricted sections. The greatest possibilities of the variety can be realized only when it is grown under the best cultural conditions. As better methods of orchard management are adopted in these regions, it is possible that it will increase in commercial importance in the future for planting in locations to which it is especially adapted, because of the high favor in which the fruit is regarded both for export and domestic markets and the relatively high prices which it generally brings.

The tree makes a slow growth and under usual methods of culture in these regions is late in coming into bearing. It seldom produces crops that are of commercial value before it is 12 years old, and in the experience of many growers not until it is 18 or 20 years old. It is unusual for the trees to bear any fruit of commercial consequence more frequently than every other year, and many orchards do not produce crops oftener than every three or four years, and even less often in numerous cases. The orchards which are given the best cultivation are as a rule the ones which bear the most regularly and abundantly and are relatively the most profitable. The tree is quite subject to twig-blight in comparison with many other varieties, and bitter-rot

attacks the fruit very seriously in some cases. The latter, however, yields readily to spraying, and hence is regarded with less concern than formerly.

The wide distribution of this variety has made possible a more extensive study of its range of adaptability in these regions than of many other sorts. The results of these observations are summarized as follows:

Successful culture of this variety is commonly supposed to be confined to the black soil (Porters black loam), or "pippin soil" as it is often called, of the mountain sections of the States included in this discussion. While this may be true in a general way, it is evident that there are several types of soil on which it is reasonably successful. All the types, however, possess at least two characteristics in common, namely, a high degree of fertility and a comparatively loose, friable texture. The subsoil must also be comparatively open and porous and the location such that perfect atmospheric and soil drainage are insured. All things considered, as above indicated, Porters black loam doubtless is one of the most satisfactory types of soil for this variety, since it usually possesses the qualifications mentioned above in the highest degree. This apple is found principally in the mountains at various altitudes and in coves where Porters black loam abounds, often at elevations not exceeding the general level of the Piedmont. Even these lower points, where the drainage is good, are favorable places for this variety, though the higher altitudes are to be preferred. Most excellent fruit is grown also on Porters sandy loam, and so far as the data at hand indicate the orchards on this type are equally as productive as those on Porters black loam, although it should be stated that Porters sandy loam varies greatly in fertility, and this fact should be considered in selecting sites for orchard purposes.

One type of red clay soil on which this variety succeeds well appears at first sight to be a stiff, compact clay, but in reality it is friable and fairly porous, so that in this particular, as in the other points, it conforms to the requirements mentioned. This type is found in some parts of Nelson County, Va., and is considered especially desirable for this variety. It is probably a modification of Cecil clay, but possesses a friability and looseness of texture which this type does not have. The most desirable locations in the last-named county are on the slopes of the mountains and hills with elevations of 1,000 to 1,500 feet or more. This type of soil is also found more or less in other sections. The red loam of northeastern Georgia is somewhat similar, but it contains less clay, possesses a more friable texture, and the subsoil is more porous. In the latter section only young trees of Yellow Newtown have been observed. These have borne a medium-sized crop of fairly high-grade fruit, but premature dropping was indicated. The trees, however, were in a neglected condition.

In Rappahannock County, Va., one type of soil on which the Yellow Newtown is commonly grown is also quite like the Nelson County type. The behavior of the variety in this section does not differ materially from that farther south, but it is considered less profitable than some other kinds, especially York Imperial, and it is seldom found in other than the older orchards.

In the Piedmont types of soil throughout the regions of which Cecil clay and Cecil sandy loam are the most common, this variety is nearly a complete failure. The relatively poor atmospheric drainage of the region and the close texture of the soil probably account for the lack of success on Cecil clay, while Cecil sandy loam is lacking also in fertility. Under these strictly Piedmont conditions the fruit is usually small, unattractive in appearance, frequently drops prematurely, is subject to disease, especially to the fungi causing "cloudy" fruit, is of relatively inferior dessert quality, and is lacking in nearly every other desirable characteristic. In many instances the trees on the heavier, more compact soils are less vigorous and the foliage lighter colored than on soils better adapted to them. In the mountain orchards in North Carolina having the highest elevations this apple is less satisfactory than at intermediate points.

Yellow Transparent.

During the past few years this variety has become quite widely distributed in the Piedmont region, but it has seldom been planted in the mountains. The individual plantings consist of only a few trees each. The tree is not as a rule a strong grower, nor is it considered a long-lived tree in other sections where it has been grown extensively, although aside from its susceptibility to twig-blight, which in some cases is severe, it is not subject to any special disease. As a rule, however, in these regions blight has not been a serious matter. On account of the rather small size attained by the tree, closer planting is possible than in the case of most other sorts. Few varieties begin to bear as young as this one does. Fairly regular and abundant crops may be expected under good cultural conditions. Its season of ripening is in advance of Early Harvest, which is the early variety most often found in the older orchards.

Observations in these regions have been confined to comparatively young trees, but thus far as an early ripening sort the Yellow Transparent is giving a high degree of satisfaction wherever it has been tried. This applies to nearly the entire range of conditions existing in the Piedmont region and to at least one of the most elevated localities in western North Carolina.

York Imperial. Synonym: *Johnson's Fine Winter.*

The distribution of this variety has been quite general in the Virginia and North Carolina sections of these regions, where it rates as one of the most important market sorts. The tree is desirable as to habit of growth, being fairly vigorous and healthy aside from its susceptibility to "twig blight," which occasionally is rather severe. It begins bearing comparatively young, frequently producing crops of considerable value at 6 or 7 years of age.

The data at hand are somewhat conflicting concerning the relationship between the behavior of this variety and the conditions under which it is grown; hence only generalizations can be indicated at present. It appears to be less influenced by soil conditions than by elevation. In the Piedmont orchards having less than 1,000 to 1,200 feet elevation serious rotting and premature dropping are apt to occur, and while frequent exceptions to this have been observed it is sufficiently constant to suggest that extensive plantings of it in this region should be made cautiously, if at all, except in the northern portion, where it appears to be more nearly free from serious faults than almost any other commercial variety that is being grown and is considered one of the most profitable sorts. This applies specifically to locations in Rappahannock County in close proximity to the mountains. In the Blue Ridge region above an elevation of 1,200 to 1,500 feet premature dropping is generally less severe than it is at lower points. Especially satisfactory results have usually been obtained on Porters clay at these middle elevations, where very heavy crops are expected, at least in alternate years. If heavy dropping occurs in such cases, a sufficient quantity of fruit usually remains to result in a heavy crop. At the higher altitudes this is considered a valuable variety, especially in North Carolina, where it has grown at 2,500 to 3,500 feet altitude.

It is frequently found advisable to harvest the crop of this variety somewhat earlier than that of most of the other commercial sorts on account of its tendency to drop, but this is not necessarily an objection in large orchards, where the harvesting must extend over a considerable period of time.

The contrast between this variety and Winesap in the manner in which they respond to the influence of elevation is of interest. The elevation at which the Winesap begins to deteriorate and above which it becomes more inferior as the elevation increases appears to be about the point below which York Imperial is inclined to manifest certain faults which tend to disappear at higher altitudes.

PEARS.

Pear culture is not a commercial industry in any portion of the Piedmont or Blue Ridge regions. There are a few orchards of considerable size at widely separated points, but the aggregate of the fruit produced is relatively small and of little consequence considered from the standpoint of supplying any extensive market demands. Only a small number of the more common varieties are being cultivated. Brief mention of the most important ones follows.

VARIETIES.

Angouleme. Synonym: *Duchesse de Angouleme.*

Trees 10 or 12 years old of this variety are giving promising results in Bedford County, Va., where they are growing on Porters clay at 1,500 feet elevation. Harvesting usually occurs from the first to the middle of September.

Bartlett.

This variety occurs occasionally in the Piedmont region of Virginia, but only very rarely in any other section of the territory under consideration. It has been observed at but one point in the Blue Ridge. The chief difficulty with this variety is the susceptibility of the tree to blight. This disease is frequently very severe at the points where the variety has been observed. The fruit grown in these regions ripens from the middle of August to the middle of September, as influenced primarily by the elevation at which it is produced.

Excellent fruit is grown where the trees remain in good condition in the Piedmont region of Virginia. It has been located in one mountain orchard in North Carolina at an elevation of 3,500 feet or more on a friable loam, where it is evidently fairly satisfactory. The only other point in the latter State from which this variety has been reported is in the Piedmont region with an elevation of about 1,100 feet. Here the blight has been so severe that the variety has been practically discarded.

Clapp Favorite.

Notes relating to Angouleme apply also to this variety, except that it is earlier and the tree is very subject to blight.

Garber.

This variety has been observed only on Cecil sandy loam at about 1,000 feet altitude in Virginia. It appears to be well adapted to these conditions, producing excellent crops of fruit for the variety. Harvesting occurs from the middle of September to early October. The tree apparently is not particularly subject to blight.

Kieffer.

There are but a small number of large commercial plantings of this variety, but it is generally distributed in small lots throughout the Piedmont region. However, it is the only variety in these regions that is grown to any extent for market purposes. It has not been commonly planted in the mountains. The tree grows well and bears abundantly on all the Piedmont soils; the fruit develops satisfactorily, and where well cared for and properly handled it develops a higher dessert quality than it does under many conditions, especially at northern latitudes. This applies especially to points in the southern portion of the Piedmont. The orchards in North Carolina having altitudes of 3,500 feet or more are evidently above the range of its satisfactory development. While the trees make a good growth at these elevations and bear heavy crops, the fruit assumes the characteristics of northern-grown specimens. The texture of the fruit at these high points is hard and woody, the color less attractive,

the flavor poorer, and the size smaller than when grown under the Piedmont conditions. The last of September to early October is the harvest period, the exact time being governed by the conditions under which it is grown.

Le Conte.

Conditions which are favorable for the Kieffer and the Garber have generally proved well suited to this variety. It is also growing on the deep red loam of northeastern Georgia at an altitude of 1,500 to 1,700 feet. The fruit develops well here, but the trees have sometimes blighted considerably, though apparently no more subject to blight than under other conditions of soil and elevation. Sometimes at the more southern points harvesting is begun the last of July, but usually August to early September covers the period.

Seckel.

A small number of fruit growers in the northern portion of the Piedmont have mentioned this variety, but its distribution in this region is very limited. It is said to give good results on Cecil sandy loam and on the lower mountain slopes where the soil approaches Porters sandy loam in texture. It has been reported favorably from western North Carolina at 3,500 to 3,800 feet elevation; also at 1,100 feet it is said to give satisfactory results. In the Virginia portion of the Piedmont region it is usually picked the last of August to the middle of September. The tree appears to be less subject to blight than many varieties are.

PEACHES.

Of the orchard fruits which are being grown in the Piedmont and Blue Ridge regions, the peach is next to the apple in commercial importance, though in comparison with the latter the industry is small except in a few localities. There is but a small number of orchards at high elevations, the most of them being at the Piedmont altitudes or along the foothills and lower slopes of the mountain sides.

The commercial development of the peach industry has been more or less centralized in certain localities. While individual orchards are scattered throughout the regions in question, the aggregate product of which is considerable, they have no appreciable influence upon the general market, since their output is practically all required to supply the local demand. Of the more important commercial centers, Albemarle County, Va., has become somewhat conspicuous during the past fifteen years or so, because of the late peaches which are produced along the lower slopes of the Blue Ridge. There are also orchards of commercial importance in Amherst and Bedford counties, as well as at other points in this State, but they are considerably isolated in their location with reference to one another and, as above stated, supply, mostly, only local needs. The same thing is true in the corresponding sections of North Carolina and South Carolina.

Northern Georgia is relatively the most important portion of these regions as a peach-growing section. The orchards are still young, but many of them are extensive, and the product of the region is a recognized factor in the peach market.

The varieties that are commonly grown have not been studied in relation to their adaptability to the conditions as critically as is desirable, since personal inspection during the ripening period has been impracticable in most cases, and hence the verification of the identity of but few of the varieties has been possible. The notes relating to the behavior of the several varieties referred to are based on the experience and opinions of the growers, not on personal observation, except in a few instances.

Some reference is made under nearly every variety to its time of ripening in some particular section. While the dates mentioned indicate as nearly as possible average periods of ripening, attention should be called to the fact that there is frequently considerable difference from year to year. Hence, the dates given should be interpreted as coming within the probable range of the ripening period, the exact date being subject to the influence of varying climatic and other conditions.

VARIETIES.

Albright. Synonym: *Albright's Winter.*

This variety is grown in these regions only to a very limited extent and occurs at but a few points. Its late season of ripening is the one point which calls for special mention. In some seasons it is marketed as late as November from here. It seems to be quite susceptible to injury from low degrees of temperature while in bud, but the blossoms are said to endure cold to an unusual degree.

At 1,000 to 1,500 feet elevation on Porters sand on the lower slopes of the Blue Ridge and its spurs, the Albright is somewhat prized by some of the growers, particularly in Albemarle County, Va., where very profitable returns in some seasons are reported. It also does fairly well at 1,000 feet elevation in the Piedmont region of South Carolina, but the fruit is more susceptible to disease, especially scab or brown-spot, than on the slopes of the mountains. Its season of ripening is probably too late to permit of its reaching perfect maturity on the heavier clay soils of a large portion of the Piedmont region. When the fruit fails to mature in these regions because of the relative shortness of the season, it does not attain a desirable size as a rule and a great amount of fuzz develops on the skin, making it very unattractive in appearance.

Alexander.

Many orchards and small plantations in widely separated sections of these regions contain a small number of trees of this variety. Its principal value is its earliness. However, it is not of great importance commercially here, unless it be for the small grower who supplies a local market. In these regions it is essentially a June peach. At some of the earliest points picking begins the last of May, sometimes as early as the 18th or 20th, extending to early July in the more northern locations or at the higher elevations south, as, for instance, in Buncombe County, N. C., at 2,800 feet altitude.

The behavior of the Alexander peach under these conditions is suggested by the following: On the lighter soils, such as Cecil sandy loam or Porters sand of the northern portion of the Piedmont region, it does fairly well, but is not especially prized. It has also been reported on Cecil clay, which appears to be a reasonably satisfactory type on which to grow it in these regions in most instances. The decay of the fruit and its irregular ripening, one side maturing before the other, are common faults. The same characteristics are also developed in western North Carolina at 2,000 feet

elevation on sandy loam. The conditions which appear to have given the most uniform success are Porters black loam at about 2,000 feet altitude in Amherst County, Va. Here the fruit is usually but little inclined to decay.

Amsden. Synonym: *Amsden's June.*

Occasionally this variety is found in both the Piedmont and Blue Ridge orchards, but it is relatively unimportant. Like many early varieties, it is likely to rot very badly except under the most favorable conditions. It manifests this tendency to decay in western North Carolina even at 2,000 feet elevation on soil similar to Cecil sandy loam, but under these same conditions it is said to withstand relatively low degrees of temperature in bud and set fruit at times when most other varieties are killed. In Amherst County, Va., on Porters black loam at 2,000 to 2,500 feet altitude, it is said to be usually very fine. It rotted at this point during the season of 1903 for the first time, due probably to the unfavorable climatic conditions which prevailed. In the central Piedmont sections maturity is reached about the middle of June.

Arkansas Traveler.

This variety has been referred to by only one grower, who is located in Albemarle County, Va. On Porters sand at 1,000 to 1,100 feet altitude with south to southeast exposure it is considered one of the most desirable of the early sorts, ripening here the last of June. Under these conditions it does better than on Cecil clay at 1,000 feet elevation; it also develops a better color on the lighter soil. This comparison is made by the one grower who has it under the two sets of conditions mentioned, the locations being in close proximity to each other.

Beatrice.

On Cecil sandy loam at 1,000 feet altitude in Bedford County, Va., this variety does not prove to be of any particular value. The fruit ripens on one side and becomes soft before the other side is ripe. As reported from western North Carolina on similar soil at 2,000 feet altitude it is considered a standard variety. As implied elsewhere, such conflicting results as the above should receive further investigation, particularly with regard to the identity of the variety in the different locations mentioned.

Belle. Synonym: *Belle of Georgia.*

Reference to this variety has been made by growers in only the southern portion of the Piedmont region, where in the deep red loams or clay loams it is recognized as one of the leading varieties. Its season in northern Georgia is early July to the middle of the month.

Bilyeu. Synonyms: *Comet, Bilyeu's Comet, Bilyeu's October, Bilyeu's Late.*

In Albemarle County, Va., where peach culture has been developed to a considerable extent, this is the most important variety being grown. It is the latest sort to ripen of those which are being extensively cultivated, coming into the market the last of September and frequently extending nearly to the end of October, when the supply of peaches is light. At this season, good prices usually prevail and it is considered a profitable sort. At the present time it is grown but little in the Piedmont and mountain regions, except in the county named and in a few orchards in Amherst County, Va.

The Bilyeu is more sensitive to the influence of conditions under which it grows than most varieties are. The highest degree of perfection in these regions is reached on the lower slopes of the mountains, somewhat elevated above the general level of the Piedmont, where perfect atmospheric and soil drainage are insured. Excellent results are obtained on Porters sand where properly located, but Porters black loam and nearly all the loose, friable mountain types of soil are well suited to it. On Tobacco Row Mountain in Amherst County, Porters black loam, with an elevation of 2,000 to 2,500 feet, it develops very finely, and is considered one of the most satisfactory of all the varieties grown in this section. Under these conditions the fruit develops to a large size and colors very beautifully. On the heavier clay soils the behavior is entirely

different. The fruit is subject to several fungous diseases and does not develop properly, being small and inferior in every way to that from the higher altitudes.

In western North Carolina on soil similar to Cecil sandy loam, with 2,000 feet elevation, very pleasing results are also reported. But at the lower levels toward the southern extremity of the Piedmont region, the experience of the growers is similar to that of the growers in the upper Piedmont and indicates that this variety is not well adapted to this section. The fruit does not develop to a satisfactory size and in appearance is similar to that grown farther north on the heavier soils at similar distances from the mountains.

Bishop. Synonym: *Bishop's Early.*

The only location from which this variety has been reported is in Bedford County, Va., on a red clay soil similar to, if not identical with, Porters clay, at an elevation of about 1,200 feet. It is claimed to be satisfactory. The good reputation which it has made at corresponding elevations in the Allegheny Mountains on a red shale soil, together with its behavior as above mentioned, indicates a considerable range in its adaptability to soil conditions. In the central Piedmont region ripening would probably occur from the middle to the last of July.

Carman.

This is one of the more recent introductions which is promising in many locations. In the friable red clay loam and sandy loam of northeastern Georgia and western South Carolina, with elevations ranging from 1,000 to 1,700 feet, this is considered one of the most important varieties. In Albemarle County, Va., under conditions favorable to Bilyeu, it is very fine, but in this same locality on Cecil clay at 900 feet elevation it is said to rot badly and to advance rapidly from a condition which is too immature for picking to one which is too soft for shipping. In the above-mentioned county, at 900 feet elevation, its season extends from July 15 to July 25. In central Georgia it is nearly a month earlier.

Champion.

Only a small number of growers in these regions have had experience with this variety, but two having mentioned it. These have trees located on Porters sand at about 1,200 feet elevation in Albemarle County, Va., and Cecil sandy loam at 1,000 feet in Bedford County. In each case the results indicate that the Champion has considerable merit for these conditions. It is reported to endure severe climatic conditions in a sufficient degree to produce good crops of fruit when most other varieties have failed to do so under the same conditions. In the central Piedmont sections ripening would probably occur from the last of July to early August.

Chinese Cling.

The distribution of the Chinese Cling is more general than most varieties. As a rule it is proving fairly well adapted to the conditions prevailing in the Piedmont region and on the lower slopes of the mountains. In Albemarle County, Va., however, the difference in its behavior on the lowland and on the mountain slopes is as marked as with Carman. In the former location this variety is said to decay seriously, while on the mountain slopes only a short distance from the Piedmont orchard in which serious decaying occurs it is giving good results and is considered a standard sort. Cecil sandy loam at 1,000 feet altitude, a similar type at 2,000 feet in North Carolina, and a friable red clay loam in northeast Georgia having about 1,500 feet elevation are other combinations of conditions to which it seems well adapted. On a clay loam at 1,000 feet elevation in South Carolina, it is inclined to decay badly. In the Piedmont region ripening occurs from the last of July to the middle of August, the exact time depending upon elevation and other conditions.

Connett. Synonyms: *Southern Early, Connett's Southern Early.*

Few of the growers have had experience with this variety. It has been reported, however, as doing exceptionally well under three diverse combinations of conditions.

Two of these locations are in Virginia, one of which is in Amherst County on Porters black loam at 2,000 feet altitude, the other in Bedford County on Porters clay at 1,200 to 1,300 feet. The third is in South Carolina at 1,000 feet altitude, on a soil similar to Cecil clay, but which contains more sand than this type does. A wide range of adaptability is thus indicated. In the latter location its season is early July, but later farther north or at greater elevations.

Crosby.

Occasionally this variety has been mentioned in Virginia, and usually with commendation. In Albemarle County on Porters clay grading into Porters sand, at 1,100 to 1,200 feet elevation, the Crosby bears abundantly and the fruit develops to a good size for the variety, but at 1,500 feet or more the fruit is frequently too small and the skin covered with a fuzz too dense to be desirable. Cecil clay at 1,000 feet in Bedford County also appears to be well suited to this variety. Ripening occurs the last of August in the middle Piedmont sections. The buds are considered very hardy with reference to low temperatures.

Early Crawford.

This has long been a standard variety of wide distribution and it does fairly well in the Piedmont region wherever it has been grown. At high elevations in North Carolina it is said to be rather tender in bud, but when it escapes injury it develops in a satisfactory manner, especially on the friable loam, which is characteristic of certain portions of the higher altitudes. It is reported to be especially fine at some points in the "thermal belt." It is also grown with a fair degree of success on Cecil sandy loam at 1,000 feet altitude, on Cecil clay, and on various other types common to the Piedmont region. As nearly as can be determined, however, from the experiences of the growers, it possesses no merits which render it of preeminent value under most conditions in this section. Its season is early August in Bedford County, Va. It has proved undesirable as a "mountain peach" in certain other sections of the country.

Eaton. Synonym: *Eaton's Golden Cling.*

This variety is known to only a very small number of growers. It is apparently of little value here. At widely separated points on Cecil sandy loam or soil similar to this type and at elevations of about 1,000 feet it grows well, ripening about the middle of September. On a soil of similar character, at 2,000 feet, the tree is reported to be unhealthy and the fruit is said to be "knotty." It is also unsatisfactory on Porters clay at 1,300 feet in Bedford County, Va.

Elberta.

This variety holds a unique place in the development of the peach-growing interests of the country. More than any other, it has entered into the wide extension of peach culture which has taken place during the past few years.

The Elberta is more widely distributed and extensively grown in these regions than any other sort. Under nearly all the combinations of soil, elevation, and other influencing factors which these regions present, it is generally successful. Doubtless, there are conditions more favorable to a high degree of success than others, but as no personal examination of the fruit has been possible, only its general behavior can be stated. Occasionally there has been some complaint of decay, but such reports are unusual and doubtless due to local causes unless attributable to some widespread climatic conditions which are unfavorable. Some seasons the fruit rots badly on young trees which are growing rapidly, when under similar conditions the fruit on older trees does not manifest this weakness, but this is quite generally true of most, if not of all, varieties. Porters sand, Cecil sandy loam, Cecil clay, and Porters clay at the usual elevations of these types, the sandy loams of western North Carolina at 2,000 feet, the red loams and red clay loams of western South Carolina and northeastern Georgia, and Porters black loam with some modifications of this type at elevations reaching nearly

2,000 feet are all conditions under which this variety is said to be satisfactory with usual conditions of climate and other incidental factors.

One of the most important points to consider in connection with extensive plantings of this variety in any section is its season of ripening. On account of its wide range of adaptability the "Elberta season" in the market extends over a long period of time. The earliest shipments at the present time in large quantities to northern markets are made from northeastern Texas and central Georgia and begin usually early in July. About the time the heavy shipments are over from these sections the fruit is beginning to ripen in northern Georgia. In the northern portion of the Piedmont, the season extends well into August. In the Ozark region of Missouri and Arkansas its usual season of ripening is from the latter part of July to the middle of August, though not much of the fruit from this section reaches the eastern markets, where the southern crop is mostly marketed, but by this period in the season varieties of better dessert quality from other eastern sections are filling the markets. Hence the profitable production of this variety in a particular section is fully as much dependent upon its period of ripening in that section as upon its adaptability to the conditions. While this is also true in a measure of all varieties, it applies especially to this one on account of its extensive production at many widely separated points.

George IV.

If the identity is correct, this variety is of special value for Cecil sandy loam at 1,000 feet elevation in the region of Bedford County, Va. It has been referred to by a single grower at this point, who reports it, growing under these conditions, as unusually satisfactory for local markets.

Globe.

A single report from western North Carolina indicates that the variety grown under this name (which is assumed to be correct) is well adapted to the conditions under which it is being grown. These are an elevation of 1,500 to 1,700 feet, a red clay loam containing more or less gravel, sand, and fine particles of mica, and an eastern slope. The tree is said to be very prolific and the fruit to develop finely. The location is in the "thermal belt." Ripening occurs here during August. As a rule the Globe is unproductive as a "mountain peach."

Greensboro.

The only mention of this variety has been made by growers at points intermediate between the two principal peach-growing sections of these regions. On soil somewhat similar to Cecil sandy loam at 1,000 feet elevation, at 2,000 feet on Cecil clay, and at about 2,000 feet on Porters black loam it is highly prized, being considered one of the best early sorts. The fruit is said to ripen uniformly at the same time and is not much subject to decay. Being one of the newer varieties, the Greensboro has not yet been thoroughly tested, but is considered promising thus far. In central Georgia, which is south of the limits under consideration, its season is from the middle to the last of June; in Bedford County, Va., it is three to four weeks later.

Heath Cling. Synonym: *White Heath Cling.*

There is scarcely a commercial orchard in these regions which does not contain this variety. While not grown in such large numbers as many other varieties, it is one of the most widely distributed of any. It has been reported from practically all conditions which exist within the limits of the Piedmont region, and within these limits it appears to reach a uniformly high degree of perfection. The only adverse experience (if the variety is authentic) is from an orchard on Porters black loam at about 2,000 feet elevation in Amherst County, Va., where during a period of seven years only one crop has been produced. Other varieties under the same conditions have borne satisfactorily. The range of ripening in these regions covers the most of September or even greater limits in some cases.

Late Crawford.

Like some of the other varieties referred to, the Late Crawford is grown more or less at widely separated points in the Piedmont region, but not extensively in any one section. In the more important peach-growing portions of the Piedmont it is seldom mentioned. On Cecil clay, Cecil sandy loam at its various altitudes, and Porters clay it is said to give satisfactory returns. At one point in North Carolina having an altitude of 1,700 feet it is also doing fairly well. It ripens from a week to ten days after Early Crawford. As a rule, it does not do well under strictly mountain conditions in certain other sections of the country.

Levy. Synonyms: *Levy's Late, Henrietta.*

In one orchard on the south slope of Tobacco Row Mountain, in Amherst County, Va., the only location in which this peach has been found, it is considered a profitable variety to grow. The elevation is from 500 to 700 feet above the general level of the Piedmont region. The soil is a comparatively loose, friable red loam, approaching Porters sandy loam in its physical properties. Under these conditions the fruit reaches good size and has a rich yellow color which gives it an attractive appearance. It is fairly prolific. Season here, about the middle of September. The Levy is also satisfactory in one or two Piedmont locations in Virginia.

Lorentz.

In Albemarle County, Va., on the lower mountain slopes, from 1,000 to 1,500 feet altitude, this variety is being cultivated by a small number of growers. It ripens here about the middle of September. Its chief value is due to its comparatively late season.

Mountain Rose.

In general, the comments under Late Crawford apply also to this variety. The conditions under which it is being grown with success are essentially the same as for that variety. It has also been located on Porters black loam at 2,000 feet elevation in Amherst County, Va., where it is said to do well, although the fruit is rather small under these conditions. In the Piedmont region of Virginia it reaches maturity early in August.

Oldmixon.

This variety is grown to a very limited extent in Bedford County, Va., on Cecil clay and Cecil sandy loam, where it is giving good satisfaction, and under similar conditions in South Carolina it is considered profitable. It is also doing well in Albemarle County, Va., on the lower slopes of the mountains on a soil which is probably an overlapping of Porters clay and Porters sand. It develops well on the slopes of Tobacco Row Mountain, in Amherst County, but its season of ripening at this point is said to render it undesirable as a general commercial sort, since it conflicts with other more profitable varieties. Early August is its usual time of ripening in this section.

Parsons. Synonym: *Parsons' Early.*

The only report of this variety comes from Bedford County, Va. It is being grown on Porters clay or some modification of this type at about 1,200 feet elevation. It is here considered one of the most satisfactory varieties of its season and deserving of wider attention. Ripens about the middle of July.

Picquet. Synonym: *Picquet's Late.*

In the northern portion of this territory, the Picquet is grown to some extent and with good success on the lower slopes of the mountains where the soil approaches Porters sand in character. In locations at the general level of the Piedmont it is susceptible to scab or brown-spot to a very serious degree. In other sections of the country it has also proved to be rather susceptible to fungous diseases. It blossoms later than most varieties; hence, it may escape injury from late spring frosts when other varieties suffer therefrom. It ripens in early September in the regions above mentioned.

Rivers. Synonym: *Early Rivers.*

Only a small number of growers have this variety. On Cecil sandy loam at 1,000 feet elevation in Bedford County, Va., it usually gives good results. Under these conditions of soil and elevation it is generally less apt to decay than in many places. In the "thermal belt" of North Carolina on a red clay loam containing considerable sand and gravel, it is said to be very fine. The fact that it has set a full crop of fruit when most varieties were killed in the bud or during the blossoming period by severe climatic conditions gives support to a common impression that its buds are more hardy than many varieties. The Rivers reaches maturity early in July in the central sections of the Piedmont region.

St. John. Synonym: *Yellow St. John.*

In Bedford County, Va., at about 1,200 feet elevation on a soil resembling Porters clay, the St. John is said to be more subject to insect attacks than almost any other variety; it also frequently rots severely. It has been reported from North Carolina as successful on a friable red clay loam about 500 feet above the level of the adjacent Piedmont region, and from South Carolina under the usual Piedmont conditions of that section. Season in these sections, middle to the last of July.

Salway.

This variety is known to only a few growers. One, in Bedford County, Va., who is growing it on Cecil sandy loam at about 1,000 feet elevation, considers it among his best varieties under favorable climatic conditions and seldom subject to any disease. Experience in most sections of the country where this variety is grown would indicate that a location which is not well elevated above the surrounding country is not suitable for this variety on account of its susceptibility to peach scab or brown-spot. The fruit as grown in the above-mentioned Bedford County location, is said to develop, as a rule, in a satisfactory manner, ripening about the middle of September. The Salway is also grown to some extent on a similar soil in North Carolina at about 2,000 feet elevation, where it is reported to do well.

Smock.

In Albemarle County, Va., this variety is grown to a limited extent. The conditions under which the Bilyeu reaches its highest degree of perfection are also favorable for this. At the Piedmont levels the fruit does not develop properly, and it is subject to peach scab. Ripens a little before Salway.

Sneed.

The plantings of the Sneed are small and the orchards which contain it are comparatively few in number. That the buds are exceptionally resistent to relatively low temperatures was demonstrated in the spring of 1903, when it escaped injury from frosts while most varieties were severely injured thereby. It has received favorable mention from Bedford County, Va., where it is being grown on Cecil sandy loam at the usual Piedmont altitude. Its adaptability to these conditions seems rather marked in its resistance in 1903 to brown-rot, which was unusually severe on most varieties during that year. Possibly its time of ripening, which occurs here the latter part of June, may have had its bearing upon the amount of decay. Porters clay at 1,200 feet elevation also gives good results in the same county. In North Carolina at 1,500 feet on a friable red clay loam and in South Carolina in the Piedmont region adjacent to the mountains, it is being grown successfully. Here it ripens early in June. In very many places the fruit is apt to decay seriously, but this does not appear to be a conspicuous fault in this section. It is prolific under the conditions named above, but on the sandy loam soils of western North Carolina at 2,000 feet and Porters black loam at a similar altitude in certain other sections, it is said to be undesirable because of its light bearing proclivities.

Stump.

The Stump is a standard sort in many peach-growing sections, but is grown only sparingly in the regions in question. The characteristic soils and elevations of the Piedmont appear to be favorable to it, though it has not attracted any particular attention. Its season in the southern Piedmont region would probably begin the last of July, extending well into August in the northern part.

Triumph.

In Bedford County, Va., this variety has been planted more or less under several combinations of conditions, but with such uniformly unsatisfactory results that its lack of adaptability seems to be well established. Its chief defect is its liability to decay under slightly unfavorable climatic conditions. A few favorable reports concerning it have been noted. One grower who has the Triumph on Porters clay at 1,200 to 1,300 feet elevation reports it to be fairly satisfactory for its season. In North Carolina on a friable red clay loam at 1,500 to 1,700 feet elevation, also in the Piedmont region of South Carolina on a soil similar to Cecil clay but containing more sand than this type, it is favorably regarded, especially at the point referred to in North Carolina, where it reaches an unusually large size for the variety and does not show its usual tendency to decay. It is one of the earliest varieties grown in these regions and its period of ripening is rather short.

Wonderful.

Under the conditions in North Carolina which are described as being particularly well suited to the Triumph, the Wonderful is said to be one of the most satisfactory varieties grown. It is prolific, and the fruit develops to a high degree of perfection.

The varieties which have been referred to in the foregoing notes include the most important sorts which are being grown in the regions under consideration. A considerable number of others have been mentioned by growers in the interviews with them, but for various reasons, such as evident uncertainty relative to the identity, the brief time they have been under trial, or for some other equally sufficient reason, they have not been included in this discussion.

PLUMS.

Plum culture is of minor importance in these regions, and with the exception of a few relatively small orchards it is not a commercial industry. A large number of small plantings exist, consisting in many instances of only a few trees the fruit of which is intended for home use. There are relatively more plums grown in Virginia than in other portions of these regions. In most cases, the trees are given no particular care; hence, their behavior, as noted, usually represents them in a neglected condition.

It should be stated that, as with other stone fruits, the identity of the varieties referred to has been verified in only a few instances. As personal inspection of the fruit itself has been impossible, the notes below regarding varieties are based upon the experience of the growers, and usually their nomenclature has been accepted.

VARIETIES.

Abundance.

This is one of the most widely distributed of the Japanese varieties and is doubtless the most important one being grown in these regions. It rots more or less, but in a favorable season this fault is not serious as a rule. It grows well on nearly all the types of soil in the Piedmont region of Virginia, such as Cecil clay, Cecil sandy loam, and Murrill clay loam. The elevation ranges from about 900 to 1,000 feet. It is also reported to do well on Porters clay at 1,500 feet altitude. Similar reports are given from the Piedmont region of South Carolina. In northeastern Georgia it blossoms relatively early; hence injury by late spring frosts is reported to occur in a large portion of the seasons. This applies to the Japanese varieties as a group. In Albemarle County, Va., the Abundance ripens the first of July.

Bailey.

One grower in Bedford County, Va., prizes this variety especially for home use. He is growing it on Porters clay at about 1,200 feet altitude.

Burbank.

Next to Abundance, this variety is grown more commonly in the Piedmont region than any other. Its behavior corresponds closely to that of Abundance, except that it is more susceptible to brown-rot than that variety. It closely follows Abundance in sequence of ripening.

Damson.

In these regions, as in many others, almost any small blue plum is popularly called a "damson," and while they are generally of the damson type, it is not known how many different varieties or strains are included under this name. It is sufficient to state in this connection that they are generally successful in the Piedmont regions. They are not often found in the mountains. The trees are sometimes severely attacked by black-knot, but with proper attention this does not usually prove serious.

Golden. Synonym: *Gold.*

Of minor importance, though possibly possessing more value than many other varieties of its class. It is a medium-sized, golden yellow, early-ripening sort of fair quality. In the Virginia portion of the Piedmont on Cecil sandy loam it bears well, and it is also favorably reported from a location at an elevation of 1,200 feet and having Porters black loam.

Milton.

A small number of growers have this sort in their collections. It is considered efficient as a pollenizer of the Wildgoose. The quality is fairly good, ripening early. A location which may be mentioned as a type in which good results are obtained is in Albemarle County, Va., at about 900 feet elevation, on Cecil clay. Other similar Piedmont locations, doubtless also certain mountain sites, would prove equally well suited to this variety.

Red June.

On Porters clay in Bedford County, Va., at 1,200 feet altitude, the Red June has given exceptionally good results. In a large collection of varieties it has proved the most satisfactory of the Japanese sorts. It also does well in Albemarle County on Cecil clay at about 900 feet elevation, where it is considered one of the most reliable bearers of any of this group. In North Carolina on a friable red clay loam at 1,500 to 1,700 feet and in the Piedmont region of South Carolina adjacent to the mountains, it is reported to do equally well. In Bedford County, Va., its season is the last of June to early July.

Satsuma.

In many places the Satsuma rots seriously, but this weakness has not been a conspicuous fault in these regions, where, at an elevation of 1,000 feet on Cecil sandy soil

and of about 1,200 on Porters clay in Bedford County, it is grown with a good degree of satisfaction. It is desirable in both North and South Carolina under the conditions described as favorable for the Red June. This is a red-fleshed variety, prized especially for preserving and canning. Ripening occurs in the central Piedmont section not far from the middle of July.

Shropshire. Synonym: *Shropshire Damson.*

Reference has been made to this variety in commendable terms by growers who have it on the principal soil types of the Piedmont region. It is said to be much less susceptible to black-knot than the Blue Damson. It is later in ripening than most other varieties of plums grown in these regions.

Smiley.

Notes under Milton apply in general to this variety; considered an excellent variety for cross-fertilizing Wildgoose.

Wickson.

This is being grown under the principal Piedmont conditions of Virginia and South Carolina, but the trees are of too recent planting to indicate its real merits. A predisposition of the fruit to decay is noticeable in many instances. In Bedford County, Va., its season is early August.

Wildgoose.

In Virginia on Cecil clay at an altitude of about 900 feet this variety is reported to be profitable, especially where it is growing with other varieties, as Milton and Smiley, which insures cross-pollination. In Bedford County, at from 1,300 to 1,500 feet elevation on Porters clay, it is said to be a failure. The trees blossom, but do not set much fruit, and the small amount that does set usually drops. It is probable, however, that this result is due to a lack of cross-pollination. It is well adapted to the conditions in North and South Carolina referred to under Red June. In the central Piedmont sections its season begins about the last of June.

Willard.

Only one grower has mentioned this variety. Its location is in Bedford County on Porters clay, or a modification of it, with an altitude of about 1,200 feet. It does not manifest any qualities which recommend it for these conditions. In the northern Piedmont sections it ripens early in July.

CHERRIES.

There are practically no cherry orchards in the Piedmont and Blue Ridge regions. The small quantity of fruit which is grown is produced on trees that are standing in dooryards, gardens, and along fences. The opportunities for studying the adaptability of varieties is therefore limited. There is relatively more fruit grown in the Virginia portion of the Piedmont region than in other sections. Practically none is produced in the mountains at the present time, though one or two small orchards have recently been planted, but are not yet in bearing.

In view of the status of cherry growing, there is little to be said relative to the question of varieties. It will suffice merely to mention those which are most commonly reported and to state briefly the conditions under which they are grown. The identity of the varieties mentioned has not been verified.

The elevation in most cases is that of the Piedmont region, in close proximity to the mountains—about 1,000 feet. The soils on which cherries have been found are those common to this region and the lower slopes of the foothills. The sweet varieties which have been reported as doing well are Centennial, Napoleon, Oxheart, Rockport, Spanish, Tartarian, and Wood. It is claimed that Elton rots badly, and that on Porters sandy loam Ohio Beauty is unproductive. Among the more common sour varieties there are Carnation, Ida, May Duke, Morello (English), and Richmond.

The usual success of cherries in these regions would seem to indicate that conditions are well suited to the growing of this fruit, with the probability that the mountain conditions would be still more favorable. On account of the very perishable nature of the fruit, several economic factors, such as transportation facilities, location with reference to markets, and the necessary help for handling the fruit, would have to be considered in connection with any commercial development of cherry culture in these regions.

GROUPING OF VARIETIES ACCORDING TO BEHAVIOR AT DIFFERENT ALTITUDES IN DIFFERENT LATITUDES.

For the purpose of summarizing the foregoing varietal notes with reference to the adaptability of the different varieties to the different sections of these regions, the following groups of apple and peach varieties—the two kinds of fruit which are of primary commercial importance in these regions—are compiled from the varietal discussions on previous pages.

In selecting varieties for planting in any place where soil conditions are favorable for orcharding, the climatic influences are doubtless the most potent of any which need to be considered in connection with the behavior of any particular variety or varieties. As the climate of a place depends very largely upon its elevation and latitude, aside from the influence of local surroundings, these two factors are made the basis of the grouping in the present instance, since relative climatic conditions can best be expressed in these terms. Such incidental mention of soil and other conditions as appears necessary is made in connection with certain varieties.

A few varieties of both apples and peaches which are discussed but which can not be recommended for planting in these regions are omitted from the groups; and in some instances, where varieties have not been actually observed in a particular section but in which there is reason to suppose they would be satisfactory, they are included in the group for that section even though no reference to them in that section appears in the discussion. In referring to the groups which contain only a small number of varieties, it may be of advantage,

when selections are being made for planting, to consider also the varieties named in the group having the next higher or lower elevation, as the case may be.

In dividing the regions for grouping the varieties, three sections of the Piedmont and Blue Ridge regions are made on the basis of latitude, namely, northern, central, and southern. In a general way the northern sections of the Piedmont and Blue Ridge regions are considered to be the portions of these regions which are in Virginia; the central sections, the portions in North Carolina; the southern sections, the portions in South Carolina and northern Georgia. In grouping with respect to elevation, 500 feet is taken as the unit of the divisions in the Blue Ridge region. A range of 800 to 1,000 feet covers practically all of the Piedmont region under consideration.

While the varieties named in these groups are intended as a "recommended list" of varieties for the several sections, it should be fully understood that not all the sorts are of equal value for the sections and for the purposes indicated. In selecting his varieties for planting, each grower will need to make discriminations for himself, as individual likes and dislikes are important factors in such a matter as this.

The uses to which the different varieties are adapted are indicated by one or more of the letters *d*, *k*, *m*, *nm*, placed after each name, these letters indicating, respectively, "dessert," "kitchen," "market," and "near-by market" qualities. As here used, "dessert" signifies that the variety is desirable for eating in a fresh state; "kitchen," that the variety is suitable for cooking; "market" refers to salability from the grower's standpoint for dessert or kitchen purposes; "near-by market" is used to designate certain sorts which are of value for marketing in the region where they are grown but which can not be recommended for shipment to far-distant points.

APPLES.

Piedmont Region.

NORTHERN SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Domine (k), Early Harvest (dkm), Early Ripe (km), Fall Cheese (dnm), Fall Orange (dk) especially on more sandy soils, Gravenstein (dkm), Gano (m), Grimes (dm), Kinnard (dkm), McAfee (k), Maiden Blush (km), Milam (d), Nickajack (km), Oldenburg (km), Ralls (dk), Rebel (dm) in some places, Red Astrachan (km), Red June (dm), Rome Beauty (dkm) on the more sandy soils, Shockley (dm), Smith Cider (m), Smokehouse (dkm), Summer Rambo (dk), Virginia Beauty (dm), Wealthy (dkm), Winesap (dkm), Winter Paradise (dnm), Yates (dnm), Yellow Transparent (dkm).

Blue Ridge Region.

NORTHERN SECTION.

Range of elevation, 1,000 to 1,500 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Cannon Pearmain (dkm) at higher elevations, Early Ripe (km), Early Harvest (dkm), Fallawater (knm), Fall Cheese (dknm), Gravenstein (dkm), Gano (m), Grimes (dm), Kinnard (dkm), Limbertwig (km), McAfee (k), Maiden Blush (km), Milam (d), Missouri (km), Nickajack (km), Oldenburg (km), Pennock (m), Pilot (d) at higher points, Ralls (dk), Rebel (dm) in some places, Red Astrachan (km), Red June (dm), Rome Beauty (dkm), Smith Cider (m), Smokehouse (dkm), Summer Rambo (dk), Virginia Beauty (dm), Wealthy (dkm), Willow (m), Winesap (dkm) at lower points, Winter Paradise (dnm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m) at higher points.

Range of elevation, 1,500 to 2,000 feet.

Varieties: Arkansas (dm), Ben Davis (m), Buckingham (km), Cannon Pearmain (dkm), Early Harvest (dk), Fallawater (knm), Gravenstein (dkm), Gano (m), Grimes (dm) especially fine on Porters clay at lower elevations, Hoover (k), Jonathan (dm), Limbertwig (km), Maiden Blush (km), Pennock (m), Pilot (d), Ralls (dk), Rome Beauty (dkm), Smokehouse (dkm), Stayman Winesap (dkm), Virginia Beauty (dm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m).

Range of elevation, 2,000 to 2,500 feet.

Varieties: Arkansas (dm), Buckingham (km), Cannon Pearmain (dkm), Grimes (dm), Hoover (k), Jonathan (dm), Maiden Blush (km), Pennock (m), Rome Beauty (dkm), Stayman Winesap (dkm), Virginia Beauty (dm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m).

APPLES—continued.

PIEDMONT REGION—Continued.

CENTRAL SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Dula (dkm), Early Harvest (dkm), Gravenstein (dkm), Gano (m), Grimes (dm), Kinnard (dkm), Limbertwig (km), Maiden Blush (km), Oldenburg (km), Pine Stump (d), Rebel (dm), Red Astrachan (km), Red June (dm), Shockley (dm), Smokehouse (dkm), Summer Rambo (dk), Wealthy (dkm), Winesap (dkm), Yates (dm), Yellow Transparent (dkm).

BLUE RIDGE REGION—Continued.

CENTRAL SECTION.

Range of elevation, 1,000 to 1,500 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Dula (dkm), Early Harvest (dkm), Gravenstein (dkm), Gano (m), Grimes (dm), Hoover (k), Kinnard (dkm), Limbertwig (km), McAfee (k), Maiden Blush (km), Missouri (km), Oldenburg (km), Pennock (m), Pine Stump (d), Rebel (dm), Red Astrachan (km), Red June (dm), Shockley (dm), Smokehouse (dkm), Summer Rambo (dk), Virginia Beauty (dm), Wealthy (dkm), Winesap (dkm), Winter Paradise (dnm), Yellow Transparent (dkm), York Imperial (m) at higher points.

Range of elevation, 1,500 to 2,000 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Cannon Pearmain (dkm) possibly, Dula (dkm), Early Harvest (dkm), Gravenstein (dkm), Gano (m), Grimes (dm), Hoover (k), Jonathan (dm), Limbertwig (km), Maiden Blush (km), Missouri (km) probably, Oldenburg (km), Pennock (m), Rabun (dm), Red Astrachan (km), Virginia Beauty (dm), Winesap (dkm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m).

Range of elevation, 2,000 to 2,500 feet.

Varieties: Ben Davis (m), Bonum (dk), Buckingham (km), Cannon Pearmain (dkm) probably, Early Harvest (dkm), Gano (m), Grimes (dm), Hoover (k), Jonathan (dm), Limbertwig (km), Maiden Blush (dm), Missouri (km) probably, Red Astrachan (km), Rome Beauty (dkm), Stayman Winesap (dkm), Virginia Beauty (dm), Winesap (dkm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m).

APPLES—continued.

PIEDMONT REGION—Continued.

SOUTHERN SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Ben Davis (m) not a long keeper here, Early Harvest (dkm), Gano (m), Kinnard (dkm), Limbertwig (km), Red Astrachan (km), Red June (dm), Shockley (dm), Terry (dm), Winesap (dkm), Yates (dm), Yellow Transparent (dkm).

BLUE RIDGE REGION—Continued.

CENTRAL SECTION—continued.

Range of elevation, 2,500 to 3,000 feet.

Varieties: Ben Davis (m), Buckingham (km), Early Harvest (dkm), Gano (m), Grimes (dm), Hoover (k), Jonathan (dm), Limbertwig (km), Maiden Blush (km), Missouri (km) probably, Rome Beauty (dkm), Stayman Winesap (dkm), Virginia Beauty (dm), Yellow Newtown (dkm) on certain soils, Yellow Transparent (dkm), York Imperial (m).

Range of elevation, 3,000 feet or more.

Varieties: Early Harvest (dkm), Esopus (dm), Jonathan (dm), Limbertwig (km), Maiden Blush (km), Northern Spy (dkm) at highest points, Stayman Winesap (dkm), Willow (m), Yellow Transparent (dkm), York Imperial (m).

SOUTHERN SECTION.

Range of elevation, 1,000 to 1,500 feet or more.

Varieties: Ben Davis (m) not a long keeper here, Buckingham (km) probably, Disharoon (d), Early Harvest (dkm), Kinnard (dkm), Kittageskee (dk), Limbertwig (km), McAfee (k), Rabun (dm), Red Astrachan (km), Red June (dm), Shockley (dm), Terry (dm), Winesap (dkm), Yates (dm), Yellow Transparent (dkm).

PEACHES.

PIEDMONT REGION.

NORTHERN SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Alexander (dm), Bishop (m), Champion (dm) probably, Connett (dm) probably, Crosby (dm), Early Crawford (dm), Elberta (km), George IV (dnm), Greensboro (m), Heath Cling (km), Late Crawford (dm), Mountain Rose (dm), Rivers (dm), Sneed (m).

BLUE RIDGE REGION.

NORTHERN SECTION.

Range of elevation, 1,000 to 1,500 feet.

Varieties: Albright (dm), Alexander (dm), Arkansas Traveler (dm), Bilyeu (km), Bishop (m), Carman (m), Champion (dm), Chinese Cling (km), Connett (m), Crosby (dm), Early Crawford (dm), Elberta (km), Greensboro (m), Heath Cling (km), Mountain Rose (dm), Parson Early (dm), Picquet (d), Salway (m), Smock (m).

PEACHES—continued.

Piedmont Region—Continued.

CENTRAL SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Chinese Cling (km), Connett (m) probably, Early Crawford (dm) probably, Elberta (km), Greensboro (m), Heath Cling (km), Late Crawford (dm), Mountain Rose (dm).

SOUTHERN SECTION.

Range of elevation, 800 to 1,000 feet.

Varieties: Alexander (dm), Belle (dm), Carman (dm), Connett (m), Eaton (dm), Elberta (km), Heath Cling (km), Greensboro (m), Rivers (dm), Sneed (m), Triumph (dm).

Blue Ridge Region—Continued.

NORTHERN SECTION—continued.

Range of elevation, 1,500 to 2,000 feet.

Varieties: Alexander (dm), Bilyeu (km), Champion (dm) probably, Connett (m), Elberta (km), Greensboro (m), Salway (m).

Range of elevation, 2,000 to 2,500 feet.

Varieties: Alexander (dm), Amsden (dm), Champion (dm) probably, Bilyeu (km), Elberta (km), Smock (m). Doubtless many other varieties would do well in this section, though comparatively few sorts are now being cultivated commercially.

CENTRAL SECTION.

Range of elevation, 1,000 to 1,500 feet.

Varieties: Bishop (m) possibly, Chinese Cling (km), Connett (m) probably, Early Crawford (dm), Elberta (km), Greensboro (m), Heath Cling (km), Mountain Rose (dm), Rivers (dm).

Range of elevation, 1,500 to 2,000 feet.

Varieties: Beatrice (dm), Bilyeu (km), Chinese Cling (km), Connett (m) probably, Early Crawford (dm), Elberta (km), Globe (dm), Greensboro (m), Heath Cling (km), Rivers (dm), Salway (m), Triumph (dm), Wonderful (dm).

Range of elevation, 2,000 to 2,500 feet.

Varieties: Beatrice (dm), Bilyeu (km), Elberta (km), Greensboro (m), Smock (m). Doubtless many other varieties would do well in this section, though comparatively few sorts are being cultivated commercially.

SOUTHERN SECTION.

Range of elevation, 1,000 to 1,500 feet.

Varieties: Belle (dm), Carman (dm), Chinese Cling (km) at some points, Connett (m) probably, Early Crawford (dm), Elberta (km), Greensboro (m).

PHENOLOGICAL RECORDS.

An extended discussion of phenology is not considered necessary in the present connection. A concise statement describing its practical application to fruit growing will suffice. It should be explained, however, that phenology is, as defined by Bailey,[a] the "science which considers the relationship of local climates to the periodicity of the annual phenomena of living things." Primarily, it has for its object the study of climate in terms of organic life. This, at least, is the viewpoint of the climatologist. He observes organic life that he may have a more intimate knowledge of climatic conditions as they are expressed thereby. While the one studying organic life may observe the same phenomena, he seeks to express the behavior of that life in terms of the climatic influences under which it develops and to determine the relationship of them.

The practical application of phenology to fruit-growing interests is in the study of the influence upon varieties of the varying climatic conditions which prevail from season to season. It is important to know the blossoming period of a variety in relation to the probable time of occurrence of spring frosts; also the date of maturity and the occurrence of fall frosts. In the case of quickly perishable fruits, the exact period of ripening is a most essential consideration, in order that such a selection of varieties can be made that the marketing of each one will occur in a desirable sequence. There are other factors of interest, but perhaps of lesser practical importance. The field of purely scientific application is a large one, but it will not be considered here.

The following records are a compilation of the observations made on some of the more important varieties by a large number of fruit growers, under the direction of this office, in the States directly concerned in the foregoing discussions. No exhaustive deductions and correlations are advisable at this time, but the records are of value as a means of presenting certain varietal information which could not well be expressed in any other manner. While the seasons over which the records extend have been peculiar in some ways, and it is to be regretted that these records do not show more in detail the climatic conditions which have prevailed, yet it is believed that, aside from all scientific value which they possess, they will prove to be an important source of reference in selecting varieties which blossom at such times that they will be most likely to escape injurious frosts and to ripen at desirable periods. The importance of elevation and the influence of latitude are also emphasized in many instances. When considering the matter of cross-pollination to increase fruitfulness, it is important to know what varieties blossom at the same time.

[a] Survival of the Unlike, p. 288.

From the following lists such varieties can be readily selected. In each case the general conditions which are given, under which the observations have been made, will assist the reader in making the necessary correlations in formulating his deductions. For instance, if a variety of plum at 200 feet elevation blossoms on a certain date and another variety at 1,000 feet elevation blossoms on the same date, it would not be safe to conclude that they would be suitable for cross-pollination, since when grown at the same altitude, other things being equal, it is doubtful if they would blossom in the same sequence. Other factors require similar consideration in interpreting the records.

The following list of observers, with their locations, indicates the points at which observations have been made, and due credit is given for the assistance thus rendered. The column at the left of the page, marked "Observer's number," contains the number by which each observer is referred to in the tabulation of phenological data on later pages.

In the following tabulation the varieties are arranged alphabetically; under each variety the locations at which the observations were made are arranged geographically, according to the latitude, the first entry under each variety being the southernmost point at which observations were recorded.

The numbers in the column marked "Observer's number," at the left of the page, correspond with the numbers in the similar column under "List of observers." By referring to this list, the place at which each record was made and the name of the observer can be readily determined.

In many instances the duration of the varieties has been reported in general terms; hence, it has been necessary in compiling the data to assume some specific date as the limit of durability. Therefore the dates appearing under the heading "Keeps until—" should be understood to indicate the durability of the varieties only approximately, but as this quality is so influenced by conditions external to the fruit itself, a liberal interpretation is necessary in any case.

List of observers who have furnished the phenological data included in this bulletin.

Observer's number.	State.	County.	Post-office.	Grower.
1	Virginia	Albemarle	Cismont	J. E. Smith.
2	....do	....do	Crozet	Walter Whately.
3	....do	Amherst	Amherst	T. J. Cunningham.
4	....do	Bedford	Bodycamp	J. F. Deboe.
5	....do	....do	Bedford City	J. D. Keeler.
6	....do	....do	....do	J. D. Lowry.
7	....do	....do	Colemans Falls	W. H. Taylor.
8	....do	....do	Lisbon	T. J. Holdren.
9	....do	....do	Penicks, R. F. D	M. L. Hatcher.
10	....do	....do	Stewartsville	R. L. Dearing.
11	....do	Botetourt	Troutville	C. E. Layman.
12	....do	Elizabeth City	Hampton	Hampton Institute.
13	....do	Fairfax	Pender	E. B. Whaley.
14	....do	Fauquier	Morrisville	J. A. McLaughlin.
15	....do	Gloucester	Roanes	T. J. Meredith.
16	....do	Greene	Wetsels	Jos. Westel.
17	....do	King George	Comorn	T. T. Arnold.
18	....do	Loudoun	Purcellville	A. B. Davis.
19	....do	Montgomery	Blacksburg	H. L. Price.
20	....do	....do	Christiansburg	J. C. Carmody.
21	....do	Nelson	Avon	W. B. MacGregor.
22	....do	....do	Massies Mill	Withers Massie.
23	....do	....do	Nellys Ford	R. L. Hughes.
24	....do	....do	Oak Ridge	J. E. Purvis.
25	....do	Nottaway	Jennings	E. W. Rogers.
26	....do	Prince William	Manassas	J. B. Johnson.
27	....do	Richmond	Warsaw	C. H. Constable.
28	....do	Roanoke	Vinton	E. L. Wright.
29	....do	Rockingham	Dayton	W. J. Cowger.
30	....do	Shenandoah	Strasburg	G. A. Copp.
31	North Carolina	Buncombe	Asheville	J. C. Cowan.
32	....do	....do	Candler	T. P. Gaston.
33	....do	Caldwell	Lenoir	J. A. Dula.
34	....do	Cumberland	Fayetteville	J. S. Breece.
35	....do	Haywood	Waynesville	John Farrior.
36	....do	....do	....do	G. D. Greene.
37	....do	Henderson	Bear Wallow	C. Oates.
38	....do	....do	Fletcher	J. F. Livingston.
39	....do	....do	Horseshoe	Mark Moore.
40	....do	New Hanover	Wilmington	J. D. Woody.
41	....do	Polk	Tryon	W. T. Lindsey.
42	....do	Watauga	Boone	J. L. Kincaid.
43	....do	....do	Sands	C. G. Hodges.
44	South Carolina	Akin	Akin	W. Turnbull.
45	....do	....do	Whitepond	O. L. Weeks.
46	....do	Oconee	Seneca	G. W. Giguilliat.
47	....do	....do	Clemson College	C. C. Newman.
48	....do	Pickens	Liberty	J. T. Boggs.
49	....do	....do	Easley	E. E. Perry.
50	....do	Richland	Columbia	L. B. Folk.
51	....do	York	Rock Hill	H. B. Buist.
52	Georgia	Bartow	Adairsville	G. W. Boyd.
53	....do	Cobb	Atlanta [a]	R. E. Watson.
54	....do	Elbert	Middleton	E. B. Heard.
55	....do	Floyd	Rome	J. C. Logan.
56	....do	....do	....do	G. H. Miller.
57	....do	Franklin	Lavonia	T. W. Dennington.
58	....do	Gilmer	Ellijay	H. M. Ellington.
59	....do	Habersham	Cornelia	I. C. Wade.
60	....do	Irwin	Tifton [a]	N. B. Eastman.
61	....do	Jackson	Marcus	J. G. Justice.
62	....do	Sumter	Americus	C. T. Broadfield.
63	....do	Wilcox	Fitzgerald [a]	Jas. Simpson.

[a] Post-office not in same county as orchard in which observations were made.

Phenological Records—Apples.

ARKANSAS.

Observer's number.	State.	Approximate latitude (° ′)	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
49	South Carolina	34 50	1,000	SE.	Cecil clay	1904	12	Apr. 4	Apr. 14	Mar. 16	Mar. 22	July 28	Nov. 12	Nov. 14	Mar. 1
12	Virginia	37 0	5	SW.	Sandy loam	1903	7	Apr. 10	Apr. 18	Apr. 5	Apr. 25	June —		Oct. 27	
12	....do	37 0	5	SW.	....do	1904	8	Apr. 22	Apr. 30	Apr. 20	Apr. 5	June 23	Sept. 15	Oct. 17	Oct. 15
19	....do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 26	May 5	Apr. 18	Apr. 10			Oct. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 10	Apr. 18	Apr. 5	Mar. 27			....do	Mar. 1
19	....do	37 15	2,170	NW.	....do	1904	15	May 2	May 7	May 16	Apr. 19	June 20	Oct. 1	Oct. 15	
8	....do	37 20	1,000	N.	Sandy	1904	5	May 10	May 16	May 7			Oct. 20		Mar. 1
11	....do	37 25	1,400	NW.	Gravelly clay	1902	6	Apr. 20	Apr. 24	Apr. 8	Apr. 20	July —	Sept. 25		Do.
30	....do	38 55	1,000	NE.	Sandy loam	1903	10	Apr. 10	Apr. 22	Apr. 5	Apr. 1	June 10	Oct. 1		June 1

BALDWIN.

Observer's number.	State.	Approximate latitude (° ′)	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
33	North Carolina	35 55	1,200	S.	Sandy loam	1904	20	Apr. 15	May 1		May 15		Sept. 7		Sept.
19	Virginia	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 2	Apr. 18	Apr. 8			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 16	Apr. 26	Apr. 5	Mar. 27		Sept. 9	....do	Nov.
19	....do	37 15	2,170	NW.	....do	1904	15			May 16	Apr. 22	June 20		Oct. 15	
9	....do	37 25	1,800	SE.	Sandy loam	1903	10	Apr. 4	Apr. 10	Apr. 6	Apr. 12		Sept. 10		Dec.
7	....do	37 30	1,000	NE.	Clay loam	1902	26	Apr. 18	Apr. 21	Apr. —	Apr. 9		Sept. 20	Nov. —	Do.
16	....do	38 15	600		Sandy loam	1902	18	....do	....do	May 5	Apr. 20			Oct. 17	
29	....do	38 25	1,350	W.	Gravelly clay	1903	16	Apr. 11	Apr. 20		Apr. 9		Sept. 25		Jan.
14	....do	38 30	400	NE.	Cecil clay	1902	5	May 4	May 8	May 15	Apr. 16	Aug. 22		Oct. 22	
14	....do	38 30	400	NE.	....do	1903	6				Mar. 22	Aug. 1		Oct. 18	
14	....do	38 30	400	NE.	....do	1904	7				Apr. 7	July 19		Sept. 23	
26	....do	38 45	375	SE.	Sandy loam	1903	15	Apr. 9	Apr. 12	May 5	May 15	June 30	Aug. 20	Oct. 25	Nov.
30	....do	38 55	1,000	NE.	....do	1902	8	Apr. 28	Apr. 29	May 14	Apr. 16	June 15	Sept. 20		Mar.
30	....do	38 55	1,000	NE.	....do	1903	9	Apr. 5	Apr. 24	May 5	Apr. 1	June 10	Sept. 10		Dec.
30	....do	38 55	1,000	NE.	....do	1904	10	Apr. 20	May 10	May 20	Apr. 30	....do			

Phenological records—Apples—Continued.

BEN DAVIS.

Observer's number.	State.	Approximate latitude.		Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		°	′													
61	Georgia	34	0	1,400	S.	Cecil clay	1902	15	Apr. 21	Apr. 26				Oct. 3		Dec.
47	South Carolina	34	40	850	W.	do	1902		Apr. 14	Apr. 18	Mar. 21	Apr. 24		Nov. 15	Nov. 27	Mar.
58	Georgia	34	40	1,350	SE.	Clayey	1904	7	Apr. 1		Apr. 3	Apr. 5		Oct. 1		Jan.
48	South Carolina	34	45	1,000	N.	Cecil clay	1904	8	Apr. 10	Apr. 15	Apr. 4	Mar. 18		Oct. —		Feb.
49	do	34	50	1,000	SE.	do	1902	10	Apr. 12	Apr. 23	Mar. 20	Mar. 29	Aug. 20	Nov. 15	Dec. —	Jan.
49	do	34	50	1,000	SE.	do	1903	11	Apr. 11	Apr. 28	Mar. 10	Mar. 16	Aug. 16	Oct. 1	Oct. 25	Mar.
49	do	34	50	1,000	SE.	do	1904	12	Apr. 4	Apr. 13	Mar. 6	Mar. 19	July 25	Nov. 12	Nov. 14	Feb.
34	North Carolina	35	5	150	None.	Sandy loam	1902		Apr. 6	Apr. 18		Mar. 23				
34	do	35	5	150	None.	do	1904		Mar. 23	Mar. 31						
37	do	35	25	1,990	SE.	Mountain loam	1904	15	Apr. 30	May 5		May 5		Sept. 23	Oct. 24	Jan.
38	do	35	25	2,100	W.	Porous loam	1902	15	Apr. 26	May 2	Apr. 5	Apr. 23	July 1	Sept. 20	Oct. 15	Feb.
38	do	35	25	2,100	W.	do	1904	16	Apr. 11	Apr. 16	Apr. 6	Apr. 14				
38	do	35	25	2,100	W.	do	1904	17	Apr. 20	May 2	Apr. 11	May 1	Aug. 8	Oct. 1	Oct. 15	Do.
36	do	35	30	2,875	SW.	Clay loam	1902	10	Apr. 29	May 8	Apr. 1	May 6	July 28	Oct. 15	do	Mar.
36	do	35	30	2,875	SW.	do	1903	11	Apr. 1	Apr. 12	Apr. 28	Apr. 5	July 15	Oct. 20	Oct. 25	Apr.
36	do	35	30	2,875	SW.	do	1904	12	Apr. 16	Apr. 25	Apr. 1	Mar. 23	June 30	Oct. 15	Oct. 16	Feb.
36	do	35	30	3,300	NE.	Porous clay	1902	6	Apr. 21	Apr. 27	Apr. 5	Apr. 24	July 30	Oct. 20	Oct. 5	Mar.
36	do	35	30	3,500	SE.	Gravelly clay	1902	12	May 1	May 10	Apr. 20	May 7	July 29	do	Oct. 3	Do.
36	do	35	30	4,000	NE.	Stony clay	1902	9	do	May 8	Apr. 25	May 9	July 30	do	do	Do.
36	do	35	30	4,500	SE.	Sandy loam	1902	11	Apr. 25	May 3	Apr. 22		do	Oct. 25	Oct. 1	Feb.
36	do	35	30	4,500	SE.	do	1903	12	May 1	May 12	Apr. 28	May 4	July 18	Oct. 10	Oct. 5	May.
32	do	35	30	2,800	E.	Clay loam	1904	8	Apr. 17	Apr. 28	Apr. 20	Apr. 7		Nov. 12	Oct. 14	
31	do	35	35	2,200	S.	do	1904	4	Apr. 15	do	do	Apr. 3			Oct. 15	
43	do	36	15	3,000	SE.	do	1904	8	Apr. 30	May 8	May 3	May 5		Oct. 7	Oct. 11	Do.
12	Virginia	37	0	5	SW.	Sandy loam	1903	7			Apr. 5	Mar. 25	Aug. 25		Oct. 27	
12	do	37	0	5	SW.	do	1904	8	Apr. 21	Apr. 30	Apr. 20	Apr. 15	June 23	Aug. 20	Oct. 17	
20	do	37	10	2,000	NW.	Loam	1902	10	Apr. 26	May 1	May 18	Apr. 20		Oct. 10	Sept. 10	Mar.
4	do	37	15	1,000	N.	Sandy loam	1903	16	Apr. 21	Apr. 11				Sept. 10		Nov.
19	do	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 26	May 3	Apr. 18	Apr. 12		Sept. 25	Sept. 14	
19	do	37	15	2,170	NW.	do	1903	14	Apr. 25	Apr. 30	Apr. 5	Mar. 30		Sept. 30	Sept. 15	
19	do	37	15	2,170	NW.	do	1904	15	May 7	May 10	Apr. 16	Apr. 23	June 22		Oct. 15	
8	do	37	20	1,000	N.	Cecil clay	1904	8	May 15	May 25	May 7			Oct. 20		Mar.
6	do	37	20	1,000	SE.	do	1902	10	Apr. 15	Apr. 20	Mar. 20	Apr. 15	July 15	Oct. 15	Oct. 20	Do.
6	do	37	20	1,000	SE.	do	1903	11	Apr. 20	May 1	Apr. 20	Apr. 20	July 20	Oct. 10	Oct. 15	Do.
6	do	37	20	1,000	SE.	do	1904	12	May 1	May 10	May 5	May 1	July 10	do	Oct. 10	Do.
9	do	37	25	1,800	SE.	do	1903	4	Apr. 4	Apr. 15	Apr. 6	Apr. 15		Sept. 15		Jan.

11	....do	37	25	1,400	NW.	Gravelly clay	1902	6	Apr. 21	Apr. 24	Apr. 8	Apr. 21	July —	Sept. 25		Mar.
7	....do	37	30	1,000	NE.	Cecil clay	1902	26	Apr. 19	Apr. 22	Mar. —	Apr. 9		Sept. 20	Nov. —	Dec.
7	....do	37	30	1,000	NE.	....do	1903	38	Apr. 18	....do	Apr. 22			Sept. 15	Oct. 26	Nov.
27	....do	37	55	200	E. & W.	Sandy loam	1902	15	Apr. 17	Apr. 23	Apr. 9	Apr. 10		Oct. —	Oct. 30	Dec.
27	....do	37	55	200	E. & W.	....do	1903	16	Mar. 29	Apr. 3		Apr. 5		....do		
27	....do	37	55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		Oct. 20	Sept. 7	
16	....do	38	15	600		....do	1904	15	Apr. 19	Apr. 24	May 3	Apr. 18			Oct. 17	
29	....do	38	25	1,350	W.	Gravelly clay	1902	16	Apr. 28	May 2		Apr. 17		Sept. 30		Feb.
29	....do	38	25	1,350	W.	....do	1903	17	Apr. 9	Apr. 30		Apr. 9		Oct. —		Do.
14	....do	38	30	400	NE.	Cecil clay	1902	15	Apr. 22	Apr. 26	Apr. 15	....do	Aug. 18	Sept. 26	Oct. 22	Mar.
14	....do	38	30	400	NE.	....do	1902	16	Apr. 2	Apr. 12	Apr. 5	Mar. 21	Aug. 6	Oct. 1	Oct. 18	Do.
14	....do	38	30	400	NE.	....do	1902	17	Apr. 30	May 5	Apr. 23	Apr. 8	July 23	Sept. 26	Sept. 23	Do.
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 8	Apr. 11	Apr. 5	Apr. 15	July 2	Sept. 15	Oct. 25	Do.
13	....do	38	50	300	W.	Cecil clay	1902	13	Apr. 18		May 30			Oct. 18	Sept. 18	Jan.
30	....do	38	55	1,000	NE.	Sandy loam	1902	14	Apr. 23	Apr. 26	Apr. 14	Apr. 14	June 15	Oct. 1		Mar.
30	....do	38	55	1,000	NE.	....do	1903	15	Apr. 6	Apr. 20	Apr. 5	Mar. 27	June 10	....do		June.
30	....do	38	55	1,000	NE.	....do	1903	16	May 2	May 7	Apr. 20	Apr. 21	....do			

BONUM.

		°	′													
34	North Carolina	35	5	150	None.	Sandy loam	1902		Apr. 7	Apr. 17		Mar. 20				
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 3	Apr. 18	Apr. 15			Sept. 14	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 20	Apr. 24	Apr. 8	Apr. 21	July —	Aug. 15		Oct.
26	....do	38	45	375	SE.	Sandy loam	1903	10	Apr. 8	Apr. 12	Apr. 5	Apr. 15		Sept. 1	Oct. 25	Dec.

EARLY HARVEST.

		°	′													
61	Georgia	35	5	1,400		Cecil clay	1902	18	Apr. 9	Apr. 15				June 12		July.
40	North Carolina	34	15	10	SW.	Sandy loam	1902	5	Feb. 27	Mar. 12	Apr. 3	Mar. 20			Nov. 24	
47	South Carolina	34	40	850		Cecil clay	1902		Apr. 13	Apr. 24	Mar. 21	Apr. 27		June 20	Nov. 27	Do.
48	....do	34	45	1,000	N.	....do	1904	8	Apr. 8	Apr. 12	Apr. 14	Mar. 20		June —		
49	....do	34	50	1,000	SE.	....do	1904	6	Apr. 4	Apr. 14	Mar. 16	Mar. 22	July 30	July 1	Nov. 14	Do.
34	North Carolina	35	5	150	None.	Sandy loam	1904		Mar. 22	Mar. 28						
37	....do	35	25	1,990	SE.	Mountain loam	1904	15	Apr. 20	Apr. 28	Apr. 21	Apr. 25		June 20	Oct. 24	Aug.
38	....do	35	25	2,100	W.	Porous loam	1902	17	Apr. 18	Apr. 24	Apr. 5	Apr. 16	July 7	July 10	Oct. 15	Do.
38	....do	35	25	2,100	W.	....do	1903	18	Mar. 28	Apr. 6	Apr. 6	Apr. 8				
38	....do	35	25	2,100	W.	....do	1904	19	Apr. 12	Apr. 20	Apr. 11	Apr. 21	July 26	July 18	Oct. 15	Aug.
36	....do	35	30	2,890	SW.	Clay loam	1902	12	Apr. 28	May 5	Apr. 1	May 4	July 30	July 25	....do	Do.
36	....do	35	30	4,500	SE.	Sandy loam	1903	12	May 1	May 10	Apr. 28	May 10	July 15	Aug. 15	Oct. 5	
32	....do	35	30	2,800	E.	Clay loam	1904	8	Apr. 18	Apr. 28	Apr. 20				Oct. 14	
31	....do	35	35	2,200	S.	....do	1902	10	Apr. 20	Apr. 26	Apr. 18	Apr. 12			Oct. 10	Do.
31	....do	35	35	2,200	S.	....do	1904	12	Apr. 12	Apr. 28	Apr. 20	Apr. 3	July 1		....do	
42	....do	36	15	3,250	S.	Sandy loam	1904	8	May 5	May 15	Apr. 21	Apr. 26	July 5	Aug. 10	Oct. 15	Sept.
43	....do	36	15	3,000	SE.	....do	1904	12	Apr. 28	May 5	May 3	May 1		....do	Oct. 11	Do.
12	Virginia	37	0	5	SW.	....do	1903	7			Apr. 5	Mar. 23		July 1	Oct. 27	July.
12	....do	37	0	5	SW.	....do	1904	8	Apr. 13	Apr. 26	Apr. 20	Mar. 28	June 23	July 5	Oct. 17	Do.
20	....do	37	10	2,000	NW.	Loam	1902	4	Apr. 24	Apr. 28	May 18	Apr. 20			Sept. 10	Aug.

Phenological records—Apples—Continued.

EARLY HARVEST—Continued.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom	Date full bloom.	Date last spring frost	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking.)	Date first fall frost.	Keeps until—
		° ′													
4	Virginia	37 15	1,000	N.	Sandy loam	1903	....	Apr. 1	Apr. 7	....	....	June 15	June 15	....	July.
25	....do	37 15	500	S.	....do	1903	16	Mar. 30	....	....	....				Do.
19	....do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 2	Apr. 18	Apr. 11	....	....	Sept. 14	
19	....do	37 15	2,170	NW.	....do	1902	14	Apr. 12	Apr. 29	Apr. 5	Mar. 26	....	....	....do..	
19	....do	37 15	2,170	NW.	....do	1902	15	....	....	May 16	Apr. 18	June 20	....	Oct. 15	
10	....do	37 20	950	W.	Porous clay	1902	27	Apr. 12	Apr. 25	Apr. 1	Apr. 15	....	July 10	Oct. 27	
10	....do	37 20	950	W.	....do	1903	28	Apr. 2	Apr. 10	Apr. 6	Mar. 28	....	June 28	Nov. 2	
8	....do	37 20	1,000	N.	Cecil clay	1904	5	May 5	May 10	May 7	Apr. 14	....	June 6	....	Do.
9	....do	37 25	1,800	SE.	Sandy loam	1902	25	Mar. 25	Apr. 6	Apr. 6	Apr. 10	....	June 24	....	Aug.
11	....do	37 25	1,400	NW.	Gravelly clay	1902	12	Apr. 19	Apr. 23	Apr. 8	Apr. 20	July —	June 15	....	July.
27	....do	37 55	200	E. & W.	Sandy loam	1902	15	Apr. 17	....do..	Apr. 9	May 10	....	July —	Oct. 30	Aug.
27	....do	37 55	200	E. & W.	....do	1903	16	Mar. 28	Apr. 2		Apr. 5	....	....do..		Do.
27	....do	37 55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25	....	July 10	Sept. 7	
16	....do	38 15	600		....do	1902	16	Apr. 18	Apr. 20	May 3	Apr. 18	....		Oct. 17	
14	....do	38 30	400	NE.	Cecil clay	1902	2	Apr. 20	Apr. 24	Apr. 15	Mar. 29	Aug. 25	....	Oct. 22	
14	....do	38 30	400	NE.	....do	1903	3	Mar. 30	Apr. 5	Apr. 5	Mar. 20	Aug. 3	July 9	Oct. 10	July.
14	....do	38 30	400	NE.	....do	1904	4	Apr. 26	May 4	Apr. 23	Apr. 3	July 3	....	Sept. 23	
26	....do	38 45	375	SE.	Sandy loam	1903	15	Apr. 8	Apr. 11	Apr. 5	Apr. 15	June 28	July 10	Oct. 25	Do.
30	....do	38 55	1,000	NE.	....do	1902	18	Apr. 23	Apr. 28	Apr. 14	May 14	June 6	July 1	....	Do.
30	....do	38 55	1,000	NE.	....do	1903	19	Apr. 9	Apr. 20	Apr. 5	Mar. 27	June 10	July 4	....	Do.
30	....do	38 55	1,000	NE.	....do	1904	20	May 1	May 6	Apr. 20	Apr. 19	....do..	....	....	

GANO.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom	Date full bloom.	Date last spring frost	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking.)	Date first fall frost.	Keeps until—
		° ′													
49	South Carolina	34 50	1,000	SE.	Cecil clay	1903	10	Apr. 10	Apr. 28	Mar 10	Mar. 14	Aug. 15	Sept. 20	Oct. 25	Jan.
49	....do	34 50	1,000	SE.	....do	1904	11	Apr. 7	Apr. 15	Mar. 16	Mar. 22	July 30	Nov. 12	Nov. 14	Mar.
19	Virginia	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 26	May 2	Apr. 18	Apr. 12	....	Sept. 25	Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 12	Apr. 27	Apr. 5	Apr. 7	....	Oct. 1	....do...	Jan.
19	....do	37 15	2,170	NW.	....do	1904	15	May 7	May 12	May 16	Apr. 20	June 24	....	Oct. 15	Mar.
29	....do	38 25	1,350	W.	Gravelly clay	1902	4	Apr. 25	May 1	....	Apr. 10	....	Oct. 1	....	Feb.
29	....do	38 25	1,350	W.	....do	1903	5	Apr. 12	Apr. 22	....	Apr. 9	....	Oct. —	....	Do.

GRAVENSTEIN.

		°	′													
12	Virginia	37	00	5	SW.	Sandy loam	1904	8	Apr. 13	Apr. 26	Apr. 20	Apr. 1	June 26	Aug. 1	Oct. 17	Aug.
19	....do	37	15	2,170	NW.	Limestone clay	1903	14	...do...	Apr. 28	Apr. 5	Mar. 25			Sept. 14	
19	....do	37	15	2,170	NW.	....do	1904	15	May 2	May 8	May 16	Apr. 20	June 26		Oct. 15	
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 25	Apr. 26	Apr. 15	Apr. 13			Oct. 22	
14	....do	38	30	400	NE.	....do	1903	16			Apr. 5				Oct. 18	
14	....do	38	30	400	NE.	....do	1904	17	Apr. 29	May 4	Apr. 23	Apr. 10	July 14		Sept. 23	
30	....do	38	55	1,000	NE.	Sandy loam	1902	8	Apr. 23	Apr. 26	Apr. 14	Apr. 15		Sept. 1		Nov.

GRIMES.

		°	′													
38	North Carolina	35	25	2,100	W.	Porous loam	1902	20	Apr. 24	May 1	Apr. 5	Apr. 22	July 8	Sept. 20	Oct. 15	Jan.
20	Virginia	37	10	2,000	NW.	Loam	1902	10	Apr. 26	....do...	May 18	Apr. 20		Oct. 10	Sept. 10	Do.
19	....do	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 27	May 4	Apr. 18	Apr. 12		Sept. 15	Sept. 14	
19	....do	37	15	2,170	NW.	....do	1903	14	Apr. 13	Apr. 26	Apr. 5	Apr. 6			....do...	Oct.
19	....do	37	15	2,170	NW.	....do	1904	15	May 7	May 12	May 16	Apr. 20	June 24		Oct. 15	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 20	Apr. 23	Apr. 8	Apr. 21	July —	Sept. 15		Dec.
29	....do	38	25	1,350	W.	....do	1903	11	Apr. 11	Apr. 21		Apr. 9		Sept. —		Do.
26	....do	38	45	375	SE.	Sandy loam	1903	10	Apr. 8	Apr. 11	Apr. 5	Apr. 16	July 1	Sept. 1	Oct. 25	Do.
30	....do	38	55	1,000	NE.	....do	1902	11	Apr. 24	Apr. 29	Apr. 14	Apr. 15	June 15	Sept. 10		Do.
30	....do	38	55	1,000	NE.	....do	1903	12	Apr. 6	Apr. 20	Apr. 5	Mar. 31	June 10	....do...		Do.
30	....do	38	55	1,000	NE.	....do	1904	13	May 4	May 8	Apr. 20	Apr. 25	....do...			

LIMBERTWIG.

		°	′													
37	North Carolina	35	25	1,990	SE.	Mountain loam	1904	20	Apr. 30	May 5	Apr. 21	Apr. 8		Oct. 20	Oct. 24	Mar.
36	....do	35	30	3,500	SE.	Gravelly clay	1902	12	Apr. 29	May 7	Apr. 20	May 10	July 28	Oct. 10	Oct. 3	Jan.
36	....do	35	30	4,000	NE.	Stony clay	1902	8	May 1	May 9	Apr. 25	May 8	....do...	Oct. 20	....do...	Mar.
36	....do	35	30	4,500	SE.	Sandy loam	1902	12	....do...	May 6	Apr. 22		July 30	....do...	Oct. 1	Feb.
31	....do	35	35	2,200	S.	Clay loam	1904	20	Apr. 15	Apr. 28	Apr. 20	Apr. 3			Oct. 15	
33	....do	35	35	1,200	S.	Sandy loam	1904	16	....do...	May 1		May 15		Nov. 1		Apr.
42	....do	36	15	3,250	S.	Clay loam	1904	15	May 10	May 20	Apr. 21	Apr. 23	July 6	Oct. 15	Oct. 15	May.
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 4	Apr. 18	Apr. 11		Sept. 25	Sept. 14	
19	....do	37	15	2,170	NW.	....do	1903	14	Apr. 17	Apr. 29	Apr. 5	Mar. 30		Oct. 1	....do...	
19	....do	37	15	2,170	NW.	....do	1904	15	May 6	May 11	May 16	Apr. 21	June 20		Oct. 15	
27	....do	37	55	200	E. & W.	Sandy loam	1903	15	Mar. 29	Apr. 4		Apr. 5		Oct. —		Mar.

Phenological records—Apples—Continued.

MAIDEN BLUSH.

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 27	May 3	Apr. 18	Apr. 10			Sept. 14	
19	do	37	15	2,170	NW.	do	1903	14	Apr. 15	Apr. 27	Apr. 5	Apr. 6			do	
19	do	37	15	2,170	NW.	do	1904	15	May 8	May 13	May 16	Apr. 22	June 27		Oct. 15	
11	do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 20	Apr. 24	Apr. 8	Apr. 20	July —	Sept. 25		Dec.
14	do	38	30	400	NE.	Cecil clay	1902	15	Apr. 24	Apr. 26	Apr. 15	Apr. 13	Aug. 25	Aug. 1	Oct. 22	Aug.
14	do	38	30	400	NE.	do	1903	16	Apr. 7	Apr. 12	Apr. 5	Mar. 20	July 28	Aug. 15	Oct. 18	Sept.
14	do	38	30	400	NE.	Cecil clay	1904	17	May 2	May 5	Apr. 23	Apr. 9	July 17		Sept. 23	
30	do	38	55	1,000	NE.	Sandy loam	1903	20	Apr. 9	Apr. 20	Apr. 5	Mar. 28	June 10	Aug. 1		Aug.

NORTHERN SPY.

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 30	May 5	Apr. 18	Apr. 11			Sept. 14	
19	do	37	15	2,170	NW.	do	1903	14	do	May 12	Apr. 5	Apr. 16		Sept. 20	do	Dec.
19	do	37	15	2,170	NW.	do	1904	15	May 9	May 14	May 16	Apr. 28	June 24		Oct. 15	
8	do	37	20	1,000	N.	Clay loam	1904	15	Apr. 15	Apr. 25	May 7			Oct. 20		Mar.
9	do	37	25	1,800	SE.	Cecil clay	1903	20	Apr. 10	Apr. 18	Apr. 6	Apr. 20		Aug. —		Dec.
26	do	38	45	375	SE.	Sandy loam	1903	15	Apr. 15	Apr. 20	Apr. 5	do	July 2	Sept. 1	Oct. 25	Nov.
30	do	38	55	1,000	NE.	do	1902	8	Apr. 26	Apr. 30	Apr. 14	Apr. 22	June 15	Sept. 20		Feb.
30	do	38	55	1,000	NE.	do	1903	9	Apr. 18	Apr. 27	Apr. 5	Apr. 6	June 10	Sept. 25		Dec.
30	do	38	55	1,000	NE.	do	1904	10	May 6	May 11	Apr. 20	May 2	do			

OLDENBURG. SYN.: *DUCHESS OF OLDENBURG.*

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
61	Georgia	34	0	1,400	S.	Clay loam	1902	18	Apr. 4	Apr. 10				June 28		
12	Virginia	37	0	5	SW.	Sandy loam	1903	7			Apr. 5	Mar. 24		July 22	Oct. 27	
12	do	37	0	5	SW.	do	1904	8	Apr. 12	Apr. 24	Apr. 20	Apr. 1	June 23	July 18	Oct. 17	
19	do	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 26	May 2	Apr. 18	Apr. 11			Sept. 14	
19	do	37	15	2,170	NW.	do	1903	14	Apr. 20	Apr. 28	Apr. 5	Mar. 27			do	

19	....do	37	15	2,170	NW.	....do	1904	15	Apr. 29	May 7	May 16	Apr. 21	June 22		Oct. 15	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 21	Apr. 27	Apr. 8	....do...	July —	July 1		
14	....do	38	30	400	NE.	Clay loam	1902	3			Apr. 15	Apr. 12	Aug. 8		Oct. 22	
14	....do	38	30	400	NE.	....do	1903	4	Apr. 8	Apr. 13	Apr. 5	Mar. 29	Aug. 3		Oct. 18	
14	....do	38	30	400	NE.	....do	1904	5	Apr. 29	May 5	Apr. 23	Apr. 10	July 17	Aug. 1	Sept. 23	

RALLS.

		°	′													
47	South Carolina	34	40	850	W.	Cecil clay	1902	...	Apr. 23	Apr. 27	Mar. 23	May 5		Nov. 10	Nov. 27	Jan.
4	Virginia	37	15	1,000	N.	Sandy loam	1903	16	Apr. 19	Apr. 25			June 25	Oct. 10		Do.
19	....do	37	15	2,170	NW.	Limestone clay	1902	13			Apr. 18		July 15	Sept. 14		
19	....do	37	15	2,170	NW.	....do	1903	14	May 7	May 12	Apr. 5	Mar. 29		....do...		Do.
19	....do	37	15	2,170	NW.	....do	1904	15			May 16	May 6		Oct. 15		
8	....do	37	20	1,000	N.	Cecil clay	1904	5	May 5	May 25	May 7			Oct. 20		Mar.
6	....do	37	20	1,000	SE.	....do	1902	15	May 1	May 10	Mar. 20	May 1	Aug. 1	Oct. 15	Oct. 20	Do.
6	....do	37	20	1,000	SE.	....do	1903	16	May 10	May 20	Apr. 20	May 10	....do...	Nov. 1	Oct. 15	Feb.
6	....do	37	20	1,000	SE.	....do	1904	17	May 15	May 25	May 5	May 15	July 20	....do...	Oct. 10	Do.
7	....do	37	30	1,000	NE.	Clay loam	1902	26	May 1	May 4	Mar. —	Apr. 20		Oct. 15	Nov. —	Do.
7	....do	37	30	1,000	NE.	....do	1904	28	....do...	May 3	Apr. 22			Sept. 15	Oct. 16	Do.
22	....do	37	50	800	SE.	....do	1903	15	Apr. 26	May 10	Apr. 15					
16	....do	38	15	600		Sandy loam	1902	18	Apr. 24	Apr. 28	May 3	Apr. 24			Oct. 17	
14	....do	38	30	400	NE.	Clay loam	1902	2			Apr. 15	Apr. 22	Aug. 29		Oct. 22	
14	....do	38	30	400	NE.	....do	1903	3			Apr. 5	Apr. 13	Aug. 4		Oct. 18	
14	....do	38	30	400	NE.	....do	1904	4			Apr. 23	Apr. 29	July 20	Oct. 1	Sept. 23	
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 6	Apr. 22	Apr. 5	Apr. 24	July 8	Sept. 30	Oct. 25	Feb.
30	....do	38	55	1,000	NE.	....do	1902	19	Apr. 30	May 3	Apr. 14	Apr. 23	June 20	Oct. 1		Mar.
30	....do	38	55	1,000	NE.	....do	1903	20	Apr. 27	May 2	Apr. 5	Apr. 9	June 10	Oct. 26		June.
30	....do	38	55	1,000	NE.	....do	1904	21	May 8	May 13	Apr. 20	May 2	....do...			

RED ASTRACHAN.

		°	′													
61	Georgia	34	5	1,400	S.	Clay loam	1902	18	Apr. 16	Apr. 20				June 18		June.
40	North Carolina	34	15	10	SW.	Sandy loam	1902	8		Mar. 24	Apr. 3	Mar. 28			Nov. 24	July.
47	South Carolina	34	40	850	W.	Cecil clay	1902	...	Apr. 17	Apr. 22	Mar. 21	Apr. 26		June 15	Nov. 27	Do.
49	....do	34	50	1,000	SE.	....do	1902	10	Apr. 11	....do...	Mar. 20	Mar. 27	Aug. 18	June 25	Dec. —	Do.
49	....do	34	50	1,000	SE.	....do	1903	11	Apr. 10	Apr. 28	Mar. 10	Mar. 17	Aug. 12	....do...	Oct. 25	Do.
49	....do	34	50	1,000	SE.	....do	1904	12	Apr. 1	Apr. 9	Mar. 16	Mar. 19	July 26	July 10	Nov. 14	Do.
38	North Carolina	35	25	2,100	W.	Porous loam	1902	19	Apr. 18	Apr. 24	Apr. 5	Apr. 16	June 25	July 1	Oct. 15	Do.
38	....do	35	25	2,100	W.	....do	1902	20	Mar. 31	Apr. 7	Apr. 6	Apr. 8				
38	....do	35	25	2,100	W.	....do	1902	21	Apr. 12	Apr. 20	Apr. 11	Apr. 22	July 26	July 10	Oct. 15	July.
31	....do	35	35	2,200	S.	....do	1902	10	Apr. 20	Apr. 26	Apr. 18	Apr. 12			....do...	Do.
31	....do	35	35	2,200	S.	....do	1904	12	Apr. 12	Apr. 28	Apr. 20	Apr. 3			....do...	
43	....do	36	15	3,000	SE.	Clay loam	1904	10	Apr. 25	May 1	May 3	May 1		Aug. 5	Oct. 11	Aug.
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 31	Apr. 10	Apr. 5	Mar. 22		July 5	Oct. 27	July.
12	....do	37	0	5	SW.	....do	1904	8	Apr. 12	Apr. 20	Apr. 20	Mar. 27	June 28	July 20	Oct. 17	Do.

Phenological records--Apples—Continued.

MAIDEN BLUSH.

Observer's number.	State.	Approximate latitude. ° ′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
19	Virginia	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 27	May 3	Apr. 18	Apr. 10			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 15	Apr. 27	Apr. 5	Apr. 6			...do...	
19	....do	37 15	2,170	NW.	....do	1904	15	May 8	May 13	May 16	Apr. 22	June 27		Oct. 15	
11	....do	37 25	1,400	NW.	Gravelly clay	1902	12	Apr. 20	Apr. 24	Apr. 8	Apr. 20	July —	Sept. 25		Dec.
14	....do	38 30	400	NE.	Cecil clay	1902	15	Apr. 24	Apr. 26	Apr. 15	Apr. 13	Aug. 25	Aug. 1	Oct. 22	Aug.
14	....do	38 30	400	NE.	....do	1903	16	Apr. 7	Apr. 12	Apr. 5	Mar. 20	July 28	Aug. 15	Oct. 18	Sept.
14	....do	38 30	400	NE.	Cecil clay	1904	17	May 2	May 5	Apr. 23	Apr. 9	July 17		Sept. 23	
30	....do	38 55	1,000	NE.	Sandy loam	1903	20	Apr. 9	Apr. 20	Apr. 5	Mar. 28	June 10	Aug. 1		Aug.

NORTHERN SPY.

Observer's number.	State.	Approximate latitude. ° ′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
19	Virginia	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 30	May 5	Apr. 18	Apr. 11			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	...do...	May 12	Apr. 5	Apr. 16		Sept. 20	...do...	Dec.
19	....do	37 15	2,170	NW.	....do	1904	15	May 9	May 14	May 16	Apr. 28	June 24		Oct. 15	
8	....do	37 20	1,000	N.	Clay loam	1904	15	Apr. 15	Apr. 25	May 7			Oct. 20		Mar.
9	....do	37 25	1,800	SE.	Cecil clay	1903	20	Apr. 10	Apr. 18	Apr. 6	Apr. 20		Aug. —		Dec.
26	....do	38 45	375	SE.	Sandy loam	1903	15	Apr. 15	Apr. 20	Apr. 5	...do...	July 2	Sept. 1	Oct. 25	Nov.
30	....do	38 55	1,000	NE.	....do	1902	8	Apr. 26	Apr. 30	Apr. 14	Apr. 22	June 15	Sept. 20		Feb.
30	....do	38 55	1,000	NE.	....do	1903	9	Apr. 18	Apr. 27	Apr. 5	Apr. 6	June 10	Sept. 25		Dec.
30	....do	38 55	1,000	NE.	....do	1904	10	May 6	May 11	Apr. 20	May 2	...do...			

OLDENBURG. SYN.: *DUCHESS OF OLDENBURG.*

Observer's number.	State.	Approximate latitude. ° ′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
61	Georgia	34 0	1,400	S.	Clay loam	1902	18	Apr. 4	Apr. 10				June 28		
12	Virginia	37 0	5	SW.	Sandy loam	1903	7			Apr. 5	Mar. 24		July 22	Oct. 27	
12	....do	37 0	5	SW.	....do	1904	8	Apr. 12	Apr. 24	Apr. 20	Apr. 1	June 23	July 18	Oct. 17	
19	....do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 26	May 2	Apr. 18	Apr. 11			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 20	Apr. 28	Apr. 5	Mar. 27			...do...	

19	....do	37	15	2,170	NW.	....do	1904	15	Apr. 29	May 7	May 16	Apr. 21	June 22	....	Oct. 15	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 21	Apr. 27	Apr. 8	...do...	July —	July 1	....	
14	....do	38	30	400	NE.	Clay loam	1902	3	....	....	Apr. 15	Apr. 12	Aug. 8	....	Oct. 22	
14	....do	38	30	400	NE.	....do	1903	4	Apr. 8	Apr. 13	Apr. 5	Mar. 29	Aug. 3	....	Oct. 18	
14	....do	38	30	400	NE.	....do	1904	5	Apr. 29	May 5	Apr. 23	Apr. 10	July 17	Aug. 1	Sept. 23	

RALLS.

		°	′													
47	South Carolina	34	40	850	W.	Cecil clay	1902	....	Apr. 23	Apr. 27	Mar. 23	May 5	....	Nov. 10	Nov. 27	Jan.
4	Virginia	37	15	1,000	N.	Sandy loam	1903	16	Apr. 19	Apr. 25	....	....	June 25	Oct. 10	....	Do.
19	....do	37	15	2,170	NW.	Limestone clay	1902	13	....	....	Apr. 18	....	July 15	Sept. 14	....	
19	....do	37	15	2,170	NW.	....do	1903	14	May 7	May 12	Apr. 5	Mar. 29	....	...do...	....	Do.
19	....do	37	15	2,170	NW.	....do	1904	15	....	....	May 16	May 6	....	Oct. 15	....	
8	....do	37	20	1,000	N.	Cecil clay	1904	5	May 5	May 25	May 7	....	....	Oct. 20	....	Mar.
6	....do	37	20	1,000	SE.	....do	1902	15	May 1	May 10	Mar. 20	May 1	Aug. 1	Oct. 15	Oct. 20	Do.
6	....do	37	20	1,000	SE.	....do	1903	16	May 10	May 20	Apr. 20	May 10	...do...	Nov. 1	Oct. 15	Feb.
6	....do	37	20	1,000	SE.	....do	1904	17	May 15	May 25	May 5	May 15	July 20	...do...	Oct. 10	Do.
7	....do	37	30	1,000	NE.	Clay loam	1902	26	May 1	May 4	Mar. —	Apr. 20	....	Oct. 15	Nov. —	Do.
7	....do	37	30	1,000	NE.	....do	1904	28	...do...	May 3	Apr. 22	....	....	Sept. 15	Oct. 16	Do.
22	....do	37	50	800	SE.	....do	1903	15	Apr. 26	May 10	Apr. 15	....	....	....	....	
16	....do	38	15	600	....	Sandy loam	1902	18	Apr. 24	Apr. 28	May 3	Apr. 24	....	....	Oct. 17	
14	....do	38	30	400	NE.	Clay loam	1902	2	....	....	Apr. 15	Apr. 22	Aug. 29	....	Oct. 22	
14	....do	38	30	400	NE.	....do	1903	3	....	....	Apr. 5	Apr. 13	Aug. 4	....	Oct. 18	
14	....do	38	30	400	NE.	....do	1904	4	....	....	Apr. 23	Apr. 29	July 20	Oct. 1	Sept. 23	
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 6	Apr. 22	Apr. 5	Apr. 24	July 8	Sept. 30	Oct. 25	Feb.
30	....do	38	55	1,000	NE.	....do	1902	19	Apr. 30	May 3	Apr. 14	Apr. 23	June 20	Oct. 1	....	Mar.
30	....do	38	55	1,000	NE.	....do	1903	20	Apr. 27	May 2	Apr. 5	Apr. 9	June 10	Oct. 26	....	June.
30	....do	38	55	1,000	NE.	....do	1904	21	May 8	May 13	Apr. 20	May 2	...do...	....	....	

RED ASTRACHAN.

		°	′													
61	Georgia	34	5	1,400	S.	Clay loam	1902	18	Apr. 16	Apr. 20	....	....	....	June 18	....	June.
40	North Carolina	34	15	10	SW.	Sandy loam	1902	8	....	Mar. 24	Apr. 3	Mar. 28	....	....	Nov. 24	July.
47	South Carolina	34	40	850	W.	Cecil clay	1902	....	Apr. 17	Apr. 22	Mar. 21	Apr. 26	....	June 15	Nov. 27	Do.
49	....do	34	50	1,000	SE.	....do	1902	10	Apr. 11	...do...	Mar. 20	Mar. 27	Aug. 18	June 25	Dec. —	Do.
49	....do	34	50	1,000	SE.	....do	1903	11	Apr. 10	Apr. 28	Mar. 10	Mar. 17	Aug. 12	...do...	Oct. 25	Do.
49	....do	34	50	1,000	SE.	....do	1904	12	Apr. 1	Apr. 9	Mar. 16	Mar. 19	July 26	July 10	Nov. 14	Do.
38	North Carolina	35	25	2,100	W.	Porous loam	1902	19	Apr. 18	Apr. 24	Apr. 5	Apr. 16	June 25	July 1	Oct. 15	Do.
38	....do	35	25	2,100	W.	....do	1902	20	Mar. 31	Apr. 7	Apr. 6	Apr. 8	....	....	....	
38	....do	35	25	2,100	W.	....do	1902	21	Apr. 12	Apr. 20	Apr. 11	Apr. 22	July 26	July 10	Oct. 15	July.
31	....do	35	35	2,200	S.	....do	1902	10	Apr. 20	Apr. 26	Apr. 18	Apr. 12	....	....	...do...	Do.
31	....do	35	35	2,200	S.	....do	1904	12	Apr. 12	Apr. 28	Apr. 20	Apr. 3	....	....	...do...	
43	....do	36	15	3,000	SE.	Clay loam	1904	10	Apr. 25	May 1	May 3	May 1	....	Aug. 5	Oct. 11	Aug.
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 31	Apr. 10	Apr. 5	Mar. 22	....	July 5	Oct. 27	July.
12	....do	37	0	5	SW.	....do	1904	8	Apr. 12	Apr. 20	Apr. 20	Mar. 27	June 28	July 20	Oct. 17	Do.

Phenological records—Apples—Continued.

RED ASTRACHAN—Continued.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
4	Virginia	37 15	1,000	N.	Sandy loam	1902	15	Apr. 19	Apr. 25						
4	do	37 15	1,000	N.	do	1903	16	Apr. 1	Apr. 8			June 5	June 18		July.
19	do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 2	Apr. 18	Apr. 11			Sept. 14	
19	do	37 15	2,170	NW.	do	1903	14	Apr. 16	Apr. 20	Apr. 5	Mar. 30			do	
19	do	37 15	2,170	NW.	do	1904	15	May 4	May 10	May 16	Apr. 20	June 20		Oct. 15	
11	do	37 25	1,400	NW.	Gravelly clay	1902	12	Apr. 21	Apr. 24	Apr. 8	Apr. 21	July —	July 1		Do.
27	do	37 55	200		Sandy loam	1902	15	Apr. 17	Apr. 23	Apr. 9	May 10		July —	Oct. 30	Aug.
27	do	37 55	200		do	1903	16	Mar. 28	Apr. 2		Apr. 5		do		July.
27	do	37 55	200		do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		July 1	Sept. 7	
14	do	38 30	400	NE.	Clay loam	1902	3	Apr. 25	Apr. 27	Apr. 15	Apr. 13	Aug. 23		Oct. 22	
14	do	38 30	400	NE.	do	1903	4	Apr. 1	Apr. 9	Apr. 5	Mar. 21	Aug. 1	July 15	Oct. 18	Do.
14	do	38 30	400	NE.	do	1904	5	May 1	May 6	Apr. 23	Apr. 9	July 11		Sept. 23	
26	do	38 45	375	SE.	Sandy loam	1903	15	Apr. 5	Apr. 8	Apr. 5	Apr. 15	June 28		Oct. 25	
30	do	38 55	1,000	NE.	do	1902	18	Apr. 22	Apr. 24	Apr. 14	do	June 15	June 28		Do.
30	do	38 55	1,000	NE.	do	1903	19	Apr. 8	Apr. 18	Apr. 5	Mar. 25	June 10	July 1		Aug.
30	do	38 55	1,000	NE.	do	1904	20	May 1	May 6	Apr. 20	Apr. 20	do			

ROME BEAUTY.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
42	North Carolina	36 15	3,250	S.	Clay loam	1904	10	May 12	May 22	Apr. 21	Apr. 25	July 18	Oct. 10	Oct. 15	May.
19	Virginia	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 5	Apr. 18	Apr. 20				
30	do	38 55	1,000	NE.	Sandy loam	1902	14	Apr. 25	Apr. 30	Apr. 14	Apr. 18	June 15	Sept. 15		Mar.
30	do	38 55	1,000	NE.	do	1903	15	Apr. 13	Apr. 27	Apr. 5	Apr. 2	June 10	Sept. 25		Jan.
30	do	38 55	1,000	NE.	do	1904	16	May 4	May 10	Apr. 20	Apr. 29	do			

SHOCKLEY.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
53	Georgia	33 30	1,000	NW.	Loam	1903	4	Mar. 20	Mar. 24	May 3					Mar.
61	do	34 5	1,400	S.	Clay loam	1902	20	Apr. 10	Apr. 15				Oct. 1		Jan.
59	do	34 30	1,600	N.	do	1904	12	Apr. 2	Apr. 12				Nov. 10	Nov. 10	Apr.

47	South Carolina	34	40	850	W.	Cecil clay	1902	....	Apr. 18	Apr. 21	Mar. 21	Apr. 24	....	Nov. 20	Nov. 27	Do.
46	....do	34	40	900	W.	....do	1904	8	Apr. 1	Apr. 9	Mar. 24	....	....	Oct. 15	....	Jan.
58	Georgia	34	40	1,350	SE.	Clay loam	1904	15	....do...	....	Apr. 3	Apr. 5	....	....do...	....	June.
48	South Carolina	34	45	1,000	N.	Cecil clay	1904	8	Apr. 8	Apr. 13	Apr. 4	Mar. 18	....	Oct. —	....	Mar.
40	....do	34	50	1,000	SE.	....do	1902	10	Apr. 11	Apr. 23	Mar. 20	Mar. 28	Sept. 1	Nov. 20	Dec. —	Do.
49	....do	34	50	1,000	SE.	....do	1903	11	Apr. 1	Apr. 12	Mar. 10	Mar. 18	Aug. 20	Oct. 1	Oct. 25	Do.
49	....do	34	50	1,000	SE.	....do	1904	12	Apr. 2	....do...	Mar. 16	Mar. 19	July 25	Nov. 12	Nov. 14	Do.
34	North Carolina	35	5	150	None.	Sandy loam	1902	....	Apr. 8	Apr. 20	Mar. 25	....	....	....	....	
34	....do	35	5	150	None.	....do	1904	....	Apr. 1	Apr. 7	....	....	....	....	....	
41	....do	35	15	1,700	SE.	Mountain loam	1903	8	....do...	....do...	Feb. —	....	....	....	Dec. —	
39	....do	35	20	2,180	NE.	Clay loam	1904	15	May 1	May 10	Apr. 17	Apr. 25	....	Oct. —	Oct. 15	Mar.
37	....do	35	25	1,990	SE.	Mountain loam	1904	15	Apr. 28	May 4	Apr. 21	May 10	....	Oct. 20	Oct. 24	Do.
36	....do	35	30	4,500	SE.	Sandy loam	1903	12	May 2	May 8	Apr. 28	May 8	July 20	Oct. 1	Oct. 5	Jan.
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 30	May 3	Apr. 18	Apr. 10	....	....	Sept. 14	
19	....do	37	15	2,170	NW.	....do	1903	14	Apr. 15	Apr. 27	Apr. 5	Apr. 5	....	Sept. 30	....do...	
19	....do	37	15	2,170	NW.	....do	1904	15	May 6	May 10	May 16	Apr. 16	June 24	....	Oct. 15	
8	....do	37	20	1,000	N.	Cecil clay	1904	12	May 15	May 25	May 7	Apr. 17	....	Oct. 20	....	Mar.
9	....do	37	25	1,800	SE.	....do	1903	4	Apr. 4	Apr. 10	Apr. 6	Apr. 18	....	Oct. 1	....	Do.

SMOKEHOUSE.

		°	′													
19	Virginia	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 24	May 2	Apr. 18	Apr. 13	....	....	Sept. 14	
28	....do	37	20	1,200	W.	Porous clay	1902	25	Apr. 16	Apr. 24	....	Apr. 4	....	....	....	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	6	Apr. 20	....do...	Apr. 8	Apr. 21	July —	Sept. 25	....	Dec.
27	....do	37	55	200	....	Sandy loam	1903	16	Mar. 30	Apr. 4	....	Apr. 5	....	Aug. 20	....	Sept.
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 23	Apr. 25	Apr. 15	Apr. 4	Aug. 20	....	Oct. 22	Do.
14	....do	38	30	400	NE.	....do	1903	16	Apr. 1	Apr. 10	Apr. 5	Mar. 22	Aug. 7	....	Oct. 18	
14	....do	38	30	400	NE.	....do	1904	17	Apr. 27	May 2	Apr. 23	Apr. 5	Aug. 2	....	Sept. 23	Sept.
13	....do	38	50	300	W.	....do	1902	13	Apr. 15	....	Apr. 30	....	....	Sept. 1	Sept. 18	
36	North Carolina	35	30	2,875	SW.	....do	1902	12	Apr. 28	May 8	Apr. 1	May 4	July 30	Oct. 20	Oct. 15	Feb.
36	....do	35	30	4,000	NE.	Stony clay	1902	6	....do...	May 6	Apr. 25	May 7	July 24	Oct. 10	Oct. 3	Dec.
36	....do	35	30	4,500	SE.	Sandy loam	1902	12	May 1	....do...	Apr. 22	....	July 27	Oct. 21	Oct. 1	Jan.
33	....do	35	55	1,200	S.	....do	1904	12	Apr. 15	May 1	....	May 15	....	Oct. —	....	
42	....do	36	15	3,250	S.	Clay loam	1904	16	May 8	May 15	Apr. 21	Apr. 24	July 21	Oct. 5	Oct. 15	Feb.

WINESAP.

		°	′													
61	Georgia	34	5	1,400	S.	Clay loam	1902	20	Apr. 18	Apr. 22	....	....	....	Aug. 15	....	Dec.
59	....do	34	30	1,600	N.	....do	1904	12	Apr. 2	Apr. 12	....	....	....	Nov. 10	Nov. 10	Apr.
49	South Carolina	34	50	1,000	SE.	Cecil clay	1902	12	Apr. 12	Apr. 25	Mar. 20	Mar. 28	Aug. 28	Nov. 20	Dec. —	Mar.
41	North Carolina	35	15	1,700	SE.	Mountain loam	1903	8	Apr. 3	Apr. 11	Feb. —	....	....	....	....do...	
39	....do	35	20	2,180	NE.	Clay loam	1904	15	May 1	May 10	Apr. 17	Apr. 25	May 30	Oct. —	Oct. 15	Do.
37	....do	35	25	1,990	SE.	Mountain loam	1904	20	Apr. 28	May 3	Apr. 21	May 8	....	Oct. 10	Oct. 24	Dec.
38	....do	35	25	2,100	W.	Porous loam	1902	18	Apr. 24	May 1	Apr. 5	Apr. 22	July 4	Sept. 30	Oct. 15	May.
38	....do	35	25	2,100	W.	....do	1903	19	Apr. 8	Apr. 13	Apr. 6	Apr. 13	Aug. 6	....	....	

Phenological records—Apples—Continued.

WINESAP Continued.

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
38	North Carolina	35	25	2,100	W.	Porous loam	1904	20	Apr. 17	Apr. 28	Apr. 11	Apr. 27	....	Oct. 1	Oct. 15	Apr.
36	....do	35	30	2,875	SW.	Clay loam	1902	10	Apr. 30	May 10	Apr. 1	May 5	July 31	Oct. 15	....do...	Feb.
36	....do	35	30	2,875	SW.	....do	1903	11	Apr. 4	Apr. 14	Apr. 28	Apr. 1	July 12	....do...	Oct. 25	Do.
36	....do	35	30	2,875	SW.	....do	1904	12	Apr. 15	Apr. 25	Apr. 1	Mar. 23	June 30	Oct. 20	Oct 16	Do.
36	....do	35	30	3,300	NE.	Porous clay	1902	6	Apr. 21	Apr. 27	Apr. 15	Apr. 21	July 31	....do...	Oct. 5	Jan.
36	....do	35	30	3,500	SE.	Gravelly clay	1902	12	Apr. 29	May 8	Apr. 20	May 5	July 30	Oct. 10	Oct. 3	Mar.
36	....do	35	30	4,000	NE.	Stony clay	1902	6	May 1	....do...	Apr. 25	May 9	July 26	Oct 15	....do...	Feb.
36	....do	35	30	4,500	SE.	Sandy loam	1902	13	Apr. 25	May 3	Apr. 22	May 8	July 30	Oct. 20	Oct. 1	Jan.
36	....do	35	30	4,500	SE.	....do	1903	14	May 3	May 10	Apr. 28	May 9	July 18	....do...	Oct 5	May.
32	....do	35	30	2,800	E.	Clay loam	1904	8	Apr. 17	Apr. 28	....	Apr. 7	....	....	Oct. 14	
31	....do	35	35	2,200	S.	....do	1904	12	Apr. 15	....do...	....	Apr. 3	....	....	Oct. 15	
33	....do	35	35	1,200	S.	Sandy loam	1904	20	....do...	May 1	....	May 15	....	....	....	
12	Virginia	37	0	5	S.	....do	1904	8	Apr. 24	Apr. 29	Apr. 20	Apr. 4	June 23	Aug. 15	Oct. 17	
20	....do	37	10	2,000	NW.	Dark loam	1902	8	Apr. 25	May 3	May 18	....	....	Oct. 20	Sept. 10	Apr.
4	....do	37	15	1,000	N.	Sandy loam	1902	15	Apr. 21	Apr. 26	....	....	June 20	....	....	Jan.
4	....do	37	15	1,000	N.	....do	1903	16	Apr. 4	Apr. 12	....	....	....	....	....	
19	....do	37	15	2,170	N.	Limestone clay	1902	13	Apr. 28	May 3	Apr. 18	Apr. 12	....	Sept. 25	Sept. 14	
19	....do	37	15	2,170	N.	....do	1903	14	Apr. 30	May 15	Apr. 5	Apr. 5	....	Sept. 30	....do...	
19	....do	37	15	2,170	N.	....do	1904	15	....	May 12	May 16	Apr. 23	June 24	....	Oct. 15	
28	....do	37	20	1,200	W.	Porous clay	1902	20	Apr. 17	Apr. 25	....	Apr. 10	....	....	....	
8	....do	37	20	1,000	N.	Cecil clay	1904	5	May 15	May 25	May 7	....	....	Oct. 20	....	Mar.
6	....do	37	20	1,000	SE.	....do	1902	15	Apr. 15	Apr. 20	Mar. 20	Apr. 15	July 15	Oct. 15	Oct. 20	Apr.
6	....do	37	20	1,000	SE.	....do	1903	16	Apr. 20	May 1	Apr. 20	Apr. 20	July 20	Oct. 10	Oct. 15	Do.
6	....do	37	20	1,000	SE.	....do	1904	17	May 1	May 10	May 5	May 1	July 10	....do...	Oct. 10	Do.
9	....do	37	25	1,500	SE.	....do	1903	10	Apr. 7	Apr. 16	Apr. 6	Apr. 20	....	Oct. 1	....	Feb.
11	....do	37	25	1,400	NW.	Gravelly clay	1902	12	Apr. 24	Apr. 26	Apr. 8	Apr. 23	July —	Sept. 25	....	Mar.
7	....do	37	30	1,000	NE.	Clay loam	1902	26	Apr. 19	Apr. 22	Mar. —	Apr. 9	....	....do...	Nov. —	Feb.

VIRGINIA BEAUTY.

		°	'													
3	Virginia	37	35	500	SE.	Cecil clay	1904	20	Apr. 24	Apr. 26		Apr. 10		Sept. 1		
22	....do	37	50	800	SE.	Porous clay	1903	20	Apr. 4	Apr. 15	Apr. 15	Apr. 25		Sept. 15		June.
23	....do	37	50	1,000	SE.	Clay loam	1903	6	Apr. 5	Apr. 18	Apr. 5	Apr. 20	June 1	Oct. 10	Oct. 27	May.
21	....do	38	0	1,300	N.	Black loam	1903	19	....do...	....do...	....do...	Mar. 25		Oct. 14	Oct. 15	Apr.
1	....do	38	5	800	W.	Sandy loam	1903	17	Apr. 4	Apr. 13	Apr. 7	Apr. 30		Oct. 1	Oct. 20	Dec.
16	....do	38	15	600		....do	1902	15	Apr. 18	Apr. 23	May 3	Apr. 18			Apr. 17	
29	....do	38	25	1,350	W.	Gravelly clay	1902	16	Apr. 26	Apr. 30	Apr. 14			Sept. 30		Mar.
29	....do	38	25	1,350	W.	....do	1903	17	Apr. 12	Apr. 22	Apr. 8			Oct. —		Do.
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 23	Apr 27	Apr. 15	Apr. 16	Aug. 16	Oct. 15	Oct. 22	Apr.
14	....do	38	30	400	NE.	....do	1903	16	Apr 7	Apr. 14	Apr. 5	Mar. 27	Aug. 5	Oct. 1	Oct. 18	Do.
14	....do	38	30	400	NE.	....do	1904	17	May 1	May 6	Apr. 22	Apr. 9	Aug. 4	Sept. 26	Sept. 23	Do.
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 10	Apr. 15	Apr 5	Apr. 18	June 30	Sept. 15	Oct. 25	Mar.
13	....do	38	50	300	W.	Clay loam	1902	13			May 30			Oct. 18	Sept. 18	Jan.
30	....do	38	55	1,000	NE.	Sandy loam	1902	14	Apr. 24	Apr. 29	Apr. 14	Apr. 17	June 15	Sept. 25		Mar.
30	....do	38	55	1,000	NE.	....do	1903	15	Apr. 10	Apr. 22	Apr. 5	Mar. 30	June 10	Sept. 30		June.
30	....do	38	55	1,000	NE.	....do	1904	16	May 3	May 9	Apr. 20	Apr. 27	....do...			
18	....do	39	10	600	NW.	Clay loam	1903	17	Apr. 17	Apr. 23						

WINTER PARADISE.

		°	'													
8	Virginia	37	20	1,000	N.	Cecil clay	1904	12	May 12	May 18	May 7			Oct. 20		Mar.
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 20	Apr. 27	Apr. 15	Mar. 31	Aug. 16	Sept. 26	Oct. 22	Jan.
14	....do	38	30	400	NE.	....do	1903	16	Mar. 31	Apr. 5	Apr. 5	Mar. 23	Aug. 1	Sept. 15	Oct. 18	Nov.
14	....do	38	30	400	NE.	....do	1904	17	Apr. 30	May 5	Apr. 23	Apr. 4	July 27	....do...	Sept. 23	Jan.
30	....do	38	55	1,000	NE.	Sandy loam	1903	20	Apr. 9	Apr. 21	Apr. 5	Mar. 28	June 10	Sept. 25		Dec.

YELLOW NEWTOWN.

		°	'													
36	North Carolina	35	30	4,500	SE.	Black loam	1902	12	May 1	May 6	Apr. 22		July 31	Oct. 25	Oct. 1	Dec.
28	Virginia	37	20	1,200	W.	Porous clay	1902	25	Apr. 10	Apr. 25		Apr. 10		Oct. 15		Mar.
9	....do	37	25	1,500	SE.	Cecil clay	1903	20	....do...	Apr. 19	Apr. 6	Apr. 25				
24	....do	37	45	1,000	SW.	Clay loam	1904	15	Apr 25		Apr. —	Apr. 10	June 15			
22	....do	37	50	800	SE.	....do	1903	20	Apr. 6	Apr. 15	Apr. 15	Apr. 25		Sept. 15		June
21	....do	38	0	1,100	N.	Black loam	1903	19			Apr. 5	Mar. 26		Sept. 28	Oct. 15	May.
30	....do	38	55	1,000	NE.	Sandy loam	1902	6	Apr. 24	Apr. 29	Apr. 14	Apr. 16	June 20			

Phenological records—Apples—Continued.

YELLOW TRANSPARENT.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
61	Georgia	34 5	1,400	S.	Clay loam	1902	12	Apr. 15	Apr. 19				June 2		June.
47	South Carolina	34 40	850	W.	Cecil clay	1902		Apr. 19	Apr. 14	Mar. 21	Apr. 29		June 27	Nov. 27	July.
49	....do	34 50	1,000	SE	....do	1902	10	Apr. 12	Apr. 22	Mar. 20	Mar. 29	Aug. 16	June 20		June.
49	....do	34 50	1,000	SE.	....do	1903	11	Apr. 11	Apr. 29	Mar. 10	Mar. 17	Aug. 11	June 25		Do.
49	....do	34 50	1,000	SE.	....do	1904	12	Apr. 6	Apr. 14	Mar. 16	Mar. 23	July 30	July 10		July.
43	North Carolina	36 15	3,000	SE.	Clay loam	1904	8	Apr. 20	Apr. 25	May 3	Apr. 20		July 20		
4	Virginia	37 15	1,000	N.	Sandy loam	1902	7	Apr. 21	Apr. 28						
4	....do	37 15	1,000	N.	....do	1903	8	Apr. 6	Apr. 11			June 1	June 10		July.
19	....do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 2	Apr. 18	Apr. 10			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 15	Apr. 26	Apr. 5	Apr. 8			....do	
19	....do	37 15	2,170	NW.	....do	1904	15			May 16	Apr. 21	June 20		Oct. 15	
8	....do	37 20	1,000	N.	Cecil clay	1904	8	May 4	May 14	May 7	Apr. 17		July 20		
9	....do	37 25	1,500	SE.	....do	1903	6	Apr. 26	Apr. 8	Apr. 6	Apr. 10				
7	....do	37 30	1,000	NE.	Clay clay	1902	5	Apr. 21	Apr. 24	Mar. —	Apr. 8		July —	Nov. —	
27	....do	37 55	200	E. & W.	Sandy loam	1902	15	Apr. 17	Apr. 23	Apr. 9	Apr. 10		July —	Oct. 30	
27	....do	37 55	200	E. & W.	....do	1903	16	Mar. 28	Apr. 2		Apr. 5		July —		
27	....do	37 55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		July 10	Sept. 9	
14	....do	38 30	400	NE.	Clay loam	1902	4			Apr. 15	Apr. 15	Aug. 24		Oct. 22	
14	....do	38 30	400	NE.	....do	1903	5	Apr. 7	Apr. 12	Apr. 5	Mar. 28	Aug. 1	June 29	Oct. 18	July.
14	....do	38 30	400	NE.	....do	1904	6	Apr 27	May 6	Apr. 23	Apr. 7	July 12	July 18	Sept. 23	Do.
26	....do	38 45	375	SE.	Sandy loam	1903	11	Apr. 8	Apr. 12	Apr. 5	Apr. 17	June 30	July 6	Oct. 25	Do.

YORK IMPERIAL.

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49	South Carolina	34	50	1,000	SE.	Cecil clay	1902	10	Apr. 12	Apr. 24	Mar. 20	Mar. 31	Sept. 1	Nov 20	Dec. —	Mar.
49	....do	34	50	1,000	SE.	....do	1903	11	Apr. 1	Apr 10	Mar. 10	Mar. 18	Aug. 22	Oct. 15	Oct. 25	Do.
49	....do	34	50	1,000	SE.	....do	1904	12	Apr 7	Apr. 15	Mar. 16	Mar. 21	July 29	Nov. 12	Nov. 14	Do.
39	North Carolina	35	20	2,180	NE.	Clay loam	1904	15	May 1	May 10	Apr. 17	Apr. 25		Oct. —	Oct. 15	
37	....do	35	25	1,990	SE.	Mountain loam	1904	20	Apr. 30	May 5	Apr 21	May 10	June 15	Sept. 25	Oct. 24	Nov.
35	....do	35	30	2,700	N.	Clay loam	1902	12			Apr. 26			Sept. 15	Oct. 16	
36	....do	35	30	2,875	SW.	....do	1903	7	Apr 6	Apr. 16	Apr. 28	Apr. 4	July 15	Oct. 28	Oct. 25	Feb.
36	....do	35	30	2,875	SW.	....do	1904	8	Apr. 15	Apr. 28	Apr. 1	Mar. 25	July 4	Oct. 15	Oct. 16	Dec.
36	....do	35	30	3,300	NE.	Gravelly clay	1902	7	Apr. 22	...do...	Apr. 15	Apr. 22	July 27	Oct. 25	Oct. 5	Feb.
36	....do	35	30	4,500	SE.	Black loam	1902	13	May 1	May 6	Apr. 22		July 31	Oct. 20	Oct. 1	Mar.
36	....do	35	30	4,500	SE.	....do	1903	14	May 5	May 18	Apr. 28	May 4	July 25	Oct. 15	Oct. 5	Feb.
42	....do	36	15	3,250	S.	Clay loam	1904	12	May 10	...do...	Apr. 21	Apr. 27	July 22	Oct. 10	Oct. 15	Apr.
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 23	Apr. 30	Apr. 20	Apr. 4	June 23	Sept. 5	Oct. 17	Nov.
20	....do	37	10	2,000	NW.	Dark loam	1902	10	Apr. 26	May 1	May 18	Apr. 20		Oct. 10	Sept. 10	Apr.
25	....do	37	15	500	S.	Sandy loam	1903	16	Apr. 2	Apr. 6						Mar.
19	....do	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 3	Apr. 18	Apr. 11		Sept. 25	Sept. 14	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	6	Apr. 21	Apr. 24	Apr. 8	Apr. 21	July —	...do...		Mar.
24	....do	37	45	1,000	SW.	Clay loam	1904	12	Apr. 24		Apr. —	Apr. 10	June 15			
22	....do	37	50	800	SE.	....do	1903	20	Mar. 24	Apr. 15	Apr. 15	Apr. 25		Sept. 15		June.
27	....do	37	55	200	E. & W.	Sandy loam	1903	16	Mar. 30	Apr. 4		Apr. 5		Oct. —		
27	....do	37	55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		Nov. 1	Sept. 7	Mar.
21	....do	38	0	1,300	N.	Black loam	1903	19			Apr. 5	Mar. 26		Oct. 2	Oct. 15	Dec.
29	....do	38	25	1,350	W.	Gravelly clay	1902	16	Apr. 26	May 1		Apr. 15		Oct. 1		Mar.
29	....do	38	25	1,350	W.	....do	1903	17	Apr. 13	Apr. 22		Apr. 10		Oct. —		Feb.
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 24	Apr. 27	Apr. 15	Apr. 15	Aug. 20	Oct. 15	Oct. 22	Mar.
14	....do	38	30	400	NE.	....do	1903	16	Apr. 12	Apr. 22	Apr. 5	Apr. 2	Aug. 4	Oct. 1	Oct. 18	Do.
14	....do	38	30	400	NE.	....do	1904	17	Apr. 30	May 6	Apr 23	Apr. 8	July 29	Sept. 26	Sept. 23	Do.
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 8	May 12	Apr. 5	Apr. 15	July 1	Sept. 15	Oct. 25	May.
30	....do	38	55	1,000	NE.	....do	1902	14	Apr. 24	Apr. 28	Apr. 14	Apr. 18	June 15	Sept. 25		Mar.
30	....do	38	55	1,000	NE.	....do	1903	15	Apr. 10	Apr. 22	Apr. 5	Apr. 2	June 10	Sept. 30		June.
30	....do	38	55	1,000	NE.	....do	1904	16	May 4	May 10	Apr. 20	Apr. 27	....do...	....do...		May.

Phenological records—Apples—Continued.

YELLOW TRANSPARENT.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
61	Georgia	34 5	1,400	S.	Clay loam	1902	12	Apr. 15	Apr. 19				June 2		June.
47	South Carolina	34 40	850	W.	Cecil clay	1902		Apr. 19	Apr. 14	Mar. 21	Apr. 29		June 27	Nov. 27	July.
49	....do	34 50	1,000	SE	....do	1902	10	Apr. 12	Apr. 22	Mar. 20	Mar. 29	Aug. 16	June 20		June.
49	....do	34 50	1,000	SE.	....do	1903	11	Apr. 11	Apr. 29	Mar. 10	Mar. 17	Aug. 11	June 25		Do.
49	....do	34 50	1,000	SE.	....do	1904	12	Apr. 6	Apr. 14	Mar. 16	Mar. 23	July 30	July 10		July.
43	North Carolina	36 15	3,000	SE.	Clay loam	1904	8	Apr. 20	Apr. 25	May 3	Apr. 20		July 20		
4	Virginia	37 15	1,000	N.	Sandy loam	1902	7	Apr. 21	Apr. 28						
4	....do	37 15	1,000	N.	....do	1903	8	Apr. 6	Apr. 11			June 1	June 10		July.
19	....do	37 15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 2	Apr. 18	Apr. 10			Sept. 14	
19	....do	37 15	2,170	NW.	....do	1903	14	Apr. 15	Apr. 26	Apr. 5	Apr. 8			...do...	
19	....do	37 15	2,170	NW.	....do	1904	15			May 16	Apr. 21	June 20		Oct. 15	
8	....do	37 20	1,000	N.	Cecil clay	1904	8	May 4	May 14	May 7	Apr. 17		July 20		
9	....do	37 25	1,500	SE.	....do	1903	6	Apr. 26	Apr. 8	Apr. 6	Apr. 10				
7	....do	37 30	1,000	NE.	Clay clay	1902	5	Apr. 21	Apr. 24	Mar. —	Apr. 8		July —	Nov. —	
27	....do	37 55	200	E. & W.	Sandy loam	1902	15	Apr. 17	Apr. 23	Apr. 9	Apr. 10		July —	Oct. 30	
27	....do	37 55	200	E. & W.	....do	1903	16	Mar. 28	Apr. 2		Apr. 5		July —		
27	....do	37 55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		July 10	Sept. 9	
14	....do	38 30	400	NE.	Clay loam	1902	4			Apr. 15	Apr. 15	Aug. 24		Oct. 22	
14	....do	38 30	400	NE.	....do	1903	5	Apr. 7	Apr. 12	Apr. 5	Mar. 28	Aug. 1	June 29	Oct. 18	July.
14	....do	38 30	400	NE.	....do	1904	6	Apr. 27	May 6	Apr. 23	Apr. 7	July 12	July 18	Sept. 23	Do.
26	....do	38 45	375	SE.	Sandy loam	1903	11	Apr. 8	Apr. 12	Apr. 5	Apr. 17	June 30	July 6	Oct. 25	Do.

YORK IMPERIAL.

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49	South Carolina	34	50	1,000	SE.	Cecil clay	1902	10	Apr. 12	Apr. 24	Mar. 20	Mar. 31	Sept. 1	Nov 20	Dec. —	Mar.
49	....do	34	50	1,000	SE.	....do	1903	11	Apr. 1	Apr 10	Mar. 10	Mar. 18	Aug. 22	Oct. 15	Oct. 25	Do.
49	....do	34	50	1,000	SE.	....do	1904	12	Apr 7	Apr. 15	Mar. 16	Mar. 21	July 29	Nov. 12	Nov. 14	Do.
39	North Carolina	35	20	2,180	NE.	Clay loam	1904	15	May 1	May 10	Apr. 17	Apr. 25		Oct. —	Oct. 15	
37	....do	35	25	1,990	SE.	Mountain loam	1904	20	Apr. 30	May 5	Apr 21	May 10	June 15	Sept. 25	Oct. 24	Nov.
35	....do	35	30	2,700	N.	Clay loam	1902	12			Apr. 26			Sept. 15	Oct. 16	
36	....do	35	30	2,875	SW.	....do	1903	7	Apr 6	Apr. 16	Apr. 28	Apr. 4	July 15	Oct. 28	Oct. 25	Feb.
36	....do	35	30	2,875	SW.	....do	1904	8	Apr. 15	Apr. 28	Apr. 1	Mar. 25	July 4	Oct. 15	Oct. 16	Dec.
36	....do	35	30	3,300	NE.	Gravelly clay	1902	7	Apr. 22	...do...	Apr 15	Apr. 22	July 27	Oct. 25	Oct. 5	Feb.
36	....do	35	30	4,500	SE.	Black loam	1902	13	May 1	May 6	Apr. 22		July 31	Oct. 20	Oct. 1	Mar.
36	....do	35	30	4,500	SE.	....do	1903	14	May 5	May 18	Apr. 28	May 4	July 25	Oct. 15	Oct. 5	Feb.
42	....do	36	15	3,250	S.	Clay loam	1904	12	May 10	...do...	Apr. 21	Apr. 27	July 22	Oct. 10	Oct. 15	Apr.
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 23	Apr. 30	Apr. 20	Apr. 4	June 23	Sept. 5	Oct. 17	Nov.
20	....do	37	10	2,000	NW.	Dark loam	1902	10	Apr. 26	May 1	May 18	Apr. 20		Oct. 10	Sept. 10	Apr.
25	....do	37	15	500	S.	Sandy loam	1903	16	Apr. 2	Apr. 6						Mar.
19	....do	37	15	2,170	NW.	Limestone clay	1902	13	Apr. 28	May 3	Apr. 18	Apr. 11		Sept. 25	Sept. 14	
11	....do	37	25	1,400	NW.	Gravelly clay	1902	6	Apr. 21	Apr. 24	Apr. 8	Apr. 21	July —	...do...		Mar.
24	....do	37	45	1,000	SW.	Clay loam	1904	12	Apr. 24		Apr. —	Apr. 10	June 15			
22	....do	37	50	800	SE.	....do	1903	20	Mar. 24	Apr. 15	Apr. 15	Apr. 25		Sept. 15		June.
27	....do	37	55	200	E. & W.	Sandy loam	1903	16	Mar. 30	Apr. 4		Apr. 5		Oct. —		
27	....do	37	55	200	E. & W.	....do	1904	17	Apr. 20	Apr. 25	Apr. 6	Apr. 25		Nov. 1	Sept. 7	Mar.
21	....do	38	0	1,300	N.	Black loam	1903	19			Apr. 5	Mar. 26		Oct. 2	Oct. 15	Dec.
29	....do	38	25	1,350	W.	Gravelly clay	1902	16	Apr. 26	May 1		Apr. 15		Oct. 1		Mar.
29	....do	38	25	1,350	W.	....do	1903	17	Apr. 13	Apr. 22		Apr. 10		Oct. —		Feb.
14	....do	38	30	400	NE.	Clay loam	1902	15	Apr. 24	Apr. 27	Apr. 15	Apr. 15	Aug. 20	Oct. 15	Oct. 22	Mar.
14	....do	38	30	400	NE.	....do	1903	16	Apr. 12	Apr. 22	Apr. 5	Apr. 2	Aug. 4	Oct. 1	Oct. 18	Do.
14	....do	38	30	400	NE.	....do	1904	17	Apr. 30	May 6	Apr 23	Apr. 8	July 29	Sept. 26	Sept. 23	Do.
26	....do	38	45	375	SE.	Sandy loam	1903	15	Apr. 8	May 12	Apr. 5	Apr. 15	July 1	Sept. 15	Oct. 25	May.
30	....do	38	55	1,000	NE.	....do	1902	14	Apr. 24	Apr. 28	Apr. 14	Apr. 18	June 15	Sept. 25		Mar.
30	....do	38	55	1,000	NE.	....do	1903	15	Apr. 10	Apr. 22	Apr. 5	Apr. 2	June 10	Sept. 30		June.
30	....do	38	55	1,000	NE.	....do	1904	16	May 4	May 10	Apr. 20	Apr. 27	...do...	...do...		May.

Phenological Records—Pears.

ANGOULEME.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
53	Georgia	33 40	1,000	N.	Sandy loam	1903	2	Mar. 12	Mar. 16	May 2					
56	do	34 15	700	SE.	Clay loam	1904	15	Mar. 23	Mar. 26						
34	North Carolina	35 5	125	None.	Sandy	1904		do	Mar. 27						
38	do	35 25	2,200	NW.	Porous loam	1903	14	Mar. 28	Apr. 4	Apr. 6	Apr. 6				
12	Virginia	37 0	5	SW.	Sandy loam	1904	8	Apr. 9	Apr. 13	Apr. 20	Apr. 3	June 23	Sept. 15	Oct. 17	
4	do	37 15	1,000	N.	do	1903	5	Mar. 25	Apr. 3						
15	do	37 20	10	None.	Clay loam	1903	24	Mar. 21	Mar. 27		Mar. 27				
15	do	37 20	10	None.	do	1904	25	Apr. 9	Apr. 12		Apr. 9		Sept. 6	Oct. 16	
27	do	37 55	200	W.	Sandy loam	1903	15	Mar. 24	Apr. 1		Apr. 5		Sept. 1		
27	do	37 55	200	W.	do	1904	16	Apr. 12	Apr. 22	Apr. 6	Apr. 25		Sept. 10	Sept. 7	
26	do	38 45	350	S. & E.	do	1903	15	Apr. 2	Apr. 6	Apr. 5		July 11		Oct. 25	

ANJOU.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
19	Virginia	37 15	2,170	NW.	Limestone clay	1903	14	Apr. 7	Apr. 14	Apr. 5	Mar. 27			Sept. 14	
19	do	37 15	2,170	NW.	do	1904	15	Apr. 26	May 1	May 16	Apr. 18			Oct. 15	
27	do	37 55	200	W.	Sandy loam	1903	15	Mar. 24	Apr. 1		Apr. 5		Sept. 1		
27	do	37 55	200	W.	do	1904	16	Apr. 12	Apr. 22	Apr. 6	Apr. 25		Sept. 10	Sept. 7	

BARTLETT.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
		° ′													
56	Georgia	34 15	700	SE.	Clay loam	1904	15	Mar. 23	Mar. 26						
49	South Carolina	34 50	1,000	S.	Cecil clay	1904	6	Mar. 16	Apr. 1	Mar. 16	Mar. 19	July 28	Sept. 10	Nov. 14	Oct.
38	North Carolina	35 25	2,200	NW.	Porous loam	1903	13	Apr. 1	Apr. 8	Apr. 6	Apr. 10				
38	do	35 25	2,200	NW.	do	1904	14	Apr. 10	Apr. 16	Apr. 11	Apr. 18	Aug. 12	Sept. 15	Oct. 15	Oct.
19	Virginia	37 15	2,170	NW.	Limestone clay	1903	14	Apr. 6	Apr. 12	Apr. 5	Apr. 7			Sept. 14	
19	do	37 15	2,170	NW.	do	1904	15	Apr. 27	May 1	May 16	Apr. 24			Oct. 15	
15	do	37 20	10	None.	Clay loam	1903	19	Mar. 28	Apr. 2						
15	do	37 20	10	None.	do	1904	20	Apr. 16	Apr. 20		Apr. 18		Aug. 1	Oct. 16	Aug.
27	do	37 55	200	E. & W.	Sandy loam	1903	15	Mar. 24	Apr. 1		Apr. 5		Aug. 15		
27	do	37 55	200	E. & W.	do	1904	16	Apr. 12	Apr. 22	Apr. 6	Apr. 25		Aug. 25	Sept. 7	

14	....do....	38	30	400	NE.	Clay loam....	1902	7	Apr. 16	Apr. 20	Apr. 15	Apr. 12	Aug. 23	Aug. 19	Oct. 22	Aug.
14	....do....	38	30	400	NE.	....do....	1903	8	Apr. 1	Apr. 24	Apr. 5	Mar. 26	Aug. 7	Sept. 20	Oct. 18	Sept.
14	....do....	38	30	400	NE.	....do....	1904	9	Apr. 23	May 1	Apr. 23	Apr. 8	July 17	Sept. 6	Sept. 23	Do.
26	....do....	38	45	350	S. & E.	Sandy loam....	1903	12	Apr. 4	Apr. 7	....	....	July 4	....	Oct. 25	
						CLAIRGEAU.										
		°	′													
19	Virginia....	37	15	2,170	NW.	....	1903	14	Apr. 9	Apr. 14	Apr. 5	Apr. 9	....	....	Sept. 14	
19	....do....	37	15	2,170	NW.	....	1904	15	Apr. 28	May 2	May 16	Apr. 18	....	....	Oct. 15	
						EARLY HARVEST.										
		°	′													
14	Virginia....	38	30	400	NE.	Clay loam....	1902	3	Apr. 22	Apr. 24	Apr. 15	Apr. 19	Aug. 23	....	Oct. 22	
14	....do....	38	30	400	NE.	....do....	1904	5	....do....	Apr. 30	Apr. 23	Apr. 9	July 11	July 29	Sept. 23	
						GARBER.										
		°	′													
49	South Carolina....	34	50	1,000	S.	Cecil clay....	1903	5	Mar. 21	Apr. 4	Mar. 10	Mar. 13	Aug. 11	Sept. 15	Oct. 25	
49	....do....	34	50	1,000	S.	....do....	1904	6	Mar. 24	Mar. 31	Mar. 16	Mar. 21	July 30	Oct. 15	Nov. 14	
						KIEFFER.										
		°	′													
60	Georgia....	31	40	450	N.	Sandy loam....	1903	7	Mar. 2	Mar. 8	Feb. 17	Mar. 3	....	Oct. 15	Nov. 14	
56	....do....	34	15	700	SE.	Clay loam....	1904	15	Mar. 17	Mar. 22	....	Mar. 26	....	....	....	
59	....do....	34	30	1,600	N.	....do....	1904	8	Mar. 20	Mar. 25	Apr. 10	Apr. 1	....	....	Nov. 10	Mar.
48	South Carolina....	34	45	1,200	S.	Cecil clay....	1904	6	Apr. 1	Apr. 10	Apr. 4	Mar. 25	....	....	Nov. —	
49	....do....	34	50	1,000	S.	....do....	1903	5	Mar. 16	Apr. 2	Mar. 10	Mar. 13	Aug. 8	Oct. 15	Oct. 25	
49	....do....	34	50	1,000	S.	....do....	1904	6	Mar. 25	Apr. 1	Mar. 16	Mar. 21	July 30	Nov. 12	Nov. 14	Jan.
51	....do....	34	55	700	SW.	Clay loam....	1902	4	Apr. 15	May 8	....	May 8	....	Aug. 20	Oct. 16	Oct.
36	North Carolina....	35	30	2,850	SW.	....do....	1904	7	Apr. 5	Apr. 15	Apr. 1	Apr. 20	July 3	Oct. 1	....do....	Dec.
12	Virginia....	37	0	5	SW.	Sandy loam....	1903	7	Apr. 20	Apr. 25	Apr. 5	Apr. 22	....	....	Oct. 27	
12	....do....	37	0	5	SW.	....do....	1903	8	Apr. 2	Apr. 16	Apr. 20	Mar. 28	June 23	....	Oct. 17	
19	....do....	37	15	2,170	W.	Limestone clay....	1903	14	Apr. 10	Apr. 15	Apr. 5	Mar. 24	....	....	Sept. 14	
19	....do....	37	15	2,170	W.	....do....	1904	15	Apr. 22	Apr. 28	May 16	Apr. 16	....	....	Oct. 15	
4	....do....	37	15	1,000	N.	Sandy loam....	1903	7	Mar. 21	Mar. 30	....	....	July 1	Sept. 25	....	Dec.
27	....do....	37	55	200	W.	....do....	1903	5	Mar. 24	Apr. 1	....	Apr. 5	....	Oct. 5	....	
27	....do....	37	55	200	W.	....do....	1904	6	Apr. 10	Apr. 15	Apr. 6	Apr. 20	....	Oct. 15	Sept. 7	Dec.
14	....do....	38	30	400	NE.	Clay loam....	1902	4	Apr. 15	Apr. 20	Apr. 15	Apr. 7	Aug. 27	Sept. 26	Oct. 22	Oct.
14	....do....	38	30	400	NE.	....do....	1903	5	Mar. 30	Apr. 2	Apr. 5	....	Aug. 11	Oct. 1	Oct. 18	Do.
14	....do....	38	30	400	NE.	....do....	1904	6	Apr. 19	Apr. 26	Apr. 23	Apr. 28	July 23	Sept. 28	Sept. 23	Do.
26	....do....	38	45	350	S. & E.	Sandy loam....	1903	8	Mar. 27	Apr. 1	Apr. 5	....	July 2	....	Oct. 25	

Phenological records—Pears—Continued.

Observer's number.	State.	Approximate latitude. (°)	Approximate latitude. (′)	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date picked (first picking).	Date first fall frost.	Keeps until—
	LE CONTE.															
56	Georgia	34	15	700	SE.	Clay loam	1904	15	Mar. 18	Mar. 23		Mar. 26				
49	South Carolina	34	50	1,000	S.	Cecil clay	1903	5	Mar. 22	Apr. 4	Apr. 10	Mar. 18	Aug. 10		Oct. 25	
49	do.	34	50	1,000	S.	do.	1904	6	Mar. 26	do.	Apr. 16	Mar. 19	July 28	Sept. 1	Nov. 14	Sept.
34	North Carolina	35	5	125	None.	Sandy loam	1904		Mar. 19	Mar. 24						
12	Virginia	37	0	5	SW.	do.	1903	7	Mar. 20	Mar. 25	Apr. 5	Mar. 22			Oct. 27	
12	do.	37	0	5	SW.	do.	1904	8	Apr. 1	Apr. 10	Apr. 20	Mar. 28	July 9	Aug. 18	Oct. 17	
15	do.	37	20	10	None.	Clay loam	1903	14	Mar. 19	Mar. 23		Mar. 20				
15	do.	37	20	10	None.	do.	1904	15	Apr. 6	Apr. 10		Apr. 4		Sept. 1	Oct. 10	
24	do.	37	45	1,000	SW.	do.	1904	13	Apr. 7	Apr. 15	Apr. —	Mar. 28	June 15	Aug. 28		
14	do.	38	30	400	NE.	do.	1902	4	Apr. 13	Apr. 19	Apr. 15	Apr. 6	Aug. 27	Sept. 20	Oct. 22	Oct.
14	do.	38	30	400	NE.	do.	1903	5	Mar. 27	Mar. 31	Apr. 5	Mar. 20	Aug. 11	Sept. 17	Oct. 18	Sept.
14	do.	38	30	400	NE.	do.	1904	6	Apr. 18	Apr. 26	Apr. 23	Mar. 6	July 24	Sept. 1	Sept. 23	Do.
26	do.	38	45	350	S. & E.	Sandy loam	1903	8	Mar. 28	Apr. 2	Apr. 5		July 2		Oct. 25	
	SECKEL.															
38	North Carolina	35	25	2,200	NW.	Porous loam	1903	12	Apr. 2	Apr. 8	Apr. 6	Apr. 8				
36	do.	35	30	2,850	SW.	Clay loam	1904	7	Apr. 6	Apr. 16	Apr. 1	Apr. 20	July 4	Oct. 1	Oct. 16	Oct.
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 13	Apr. 25	Apr. 20	Apr. 5	June 23	Sept. 1	Oct. 17	
19	do.	37	15	2,170	W.	Limestone clay	1903	14	Apr. 8	Apr. 14	Apr. 5	Apr. 6			Sept. 14	
19	do.	37	15	2,170	W.	do.	1904	15	Apr. 29	May 2	May 16	Apr. 20			Oct. 15	
4	do.	37	15	1,000	N.	Sandy loam	1903	7	Mar. 30	Apr. 8			June 15	Aug. 28		Sept.
27	do.	37	55	200	W.	do.	1903	15	Mar. 24	Apr. 1		Apr. 5		Sept. 1		
27	do.	37	55	200	W.	do.	1904	16	Apr. 15	Apr. 20	Apr. 6	Apr. 25		Sept. 10	Sept. 7	
14	do.	38	30	400	NE.	Clay loam	1902	2			Apr. 15	Apr. 15	Aug. 25		Oct. 22	
14	do.	38	30	400	NE.	do.	1903	3	Apr. 2	Apr. 5	Apr. 5	Mar. 28	Aug. 15		Oct. 18	
14	do.	38	30	400	NE.	do.	1904	4	Apr. 28	May 6	Apr. 23	Apr. 12	Aug. 8		Sept. 23	
26	do.	38	45	350	S. & E.	Sandy loam	1903	5	Apr. 4	Apr. 7	Apr. 5		July 4		Oct. 25	
	SHELDON.															
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 12	Apr. 18	Apr. 20	Apr. 6	June 23		Oct. 17	
19	do.	37	15	2,170	W.	Limestone clay	1903	15	Apr. 11	Apr. 14	Apr. 5	Apr. 10			Sept. 14	

Phenological Records—Peaches.

ALEXANDER.

Observer's number.	State.	Approximate latitude.		Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		°	'													
62	Georgia	32	5	450	S.	Light loam	1902	6	Mar. 22	Mar. 26	Feb. 27	Apr. 2		May 22	June 7	Nov. 20
62	do	32	5	450	S.	do	1903	7	Mar. 14	Mar. 20	Feb. 17	do	May 22	June 8	June 10	Nov. 10
45	South Carolina	33	25	350	E.	Sandy	1903	3	Mar. 12	Mar. 18	Mar. 11		July 15	May 18	do	Oct. 24
45	do	33	25	350	E.	do	1904	4	Mar. 14	Mar. 20	Mar. 5		June 20	May 16	June 9	Oct. 16
50	do	34	0	500	None.	Sandy loam	1902	9	Mar. 20	Mar. 27	Mar. 19	Mar. 28		May 28	June 4	
54	Georgia	34	0	700	S.	Cecil clay	1904	6	Mar. 19	do	Apr. 5	Mar. 12	Aug. 10	June 15	June 20	Oct. 22
40	North Carolina	34	15	10	S.	Sandy loam	1902	8	Mar. 1	Mar. 10	Apr. 3	Apr. 11				Nov. 24
40	do	34	15	10	S.	do	1903	9	Feb. 26	Mar. 7	Feb. 22	Mar. 20	Aug. 24	June 20		Oct. 28
58	Georgia	34	40	1,300	N.	Clay loam	1904	6	Mar. 20	Mar. 27	Apr. 4	Apr. 1		do	July 1	
47	South Carolina	34	40	850		do	1902	12	Mar. 31	Apr. 7	Mar. 21			June 18	June 25	Nov. 27
49	do	34	50	1,000	E.	Cecil clay	1902	3	Mar. 27	Apr. 5	Mar. 20	Apr. 2	Aug. 17	June 5	June 10	Nov. 28
49	do	34	50	1,000	E.	do	1903	4	Mar. 13	Mar. 19	Mar. 10	Mar. 14	Aug. 8	June 10	June 20	Oct. 25
49	do	34	50	1,000	E.	do	1904	5	Mar. 25	Apr. 2	Apr. 26	Mar. 21	July 29	June 20	July 1	Nov. 14
51	do	34	55	700	S. & E.	do	1902	4	Mar. 12	Apr. 12		Apr. 9		June 26	July 8	
38	North Carolina	35	25	2,128	W.	Porous loam	1902	8	Apr. 12	Apr. 19	Apr. 5	Apr. 21	July 8	June 27	July 5	Oct. 15
38	do	35	25	2,128	W.	do	1903	9	Mar. 27	Apr. 2	Apr. 6	Apr. 8				
38	do	35	25	2,128	W.	do	1904	10	Apr. 9	Apr. 14	Apr. 11	Apr. 16	July 10			Do.
32	do	35	30	2,800	E.	Black loam	1904	8	Apr. 4	Apr. 17	Apr. 20	Apr. 5	Aug. 20	July 1	July 10	Oct. 14
31	do	35	35	2,300	S.	Red clay	1902	4	Apr. 7	Apr. 15	Apr. 18	Apr. 20	June 20	June 28	July 5	Oct. 15
31	do	35	35	2,300	S.	do	1904	6	Apr. 6		Apr. 20	Apr. 16				Do.
42	do	36	10	3,250	S.	Black loam	1904	2	Apr. 25	Apr. 28	Apr. 21	May 3	July 23			Do.
4	Virginia	37	5	1,000	None.	Sandy loam	1902	3	Apr. 3	Apr. 9						
4	do	37	5	1,000	None.	do	1903	4	Mar. 25	Apr. 2				June 20	June 24	
5	do	37	25	1,000	N. & W.	Cecil clay	1903	3	Mar. 20	Mar. 30	Apr. 5				July 6	Oct. 30
27	do	37	55	200	S.	Sandy loam	1902	4	Apr. 10	Apr. 18	Apr. 9	Apr. 25		July 1	July 15	Do.
2	do	38	5	900	None.	Cecil clay	1902	10	Apr. 6	Apr. 15	Apr. 3	Apr. 6		June 26	June 30	Oct. —
2	do	38	5	900	None.	do	1902	3	Apr. 10	Apr. 13	do	Apr. 10				Do.
16	do	38	15	400	NE.	Sandy	1902	5	Apr. 4	Apr. 8	May 3	Apr. 18				Oct. 17
17	do	38	15	150	S.	Sandy loam	1902		Apr. 2	Apr. 14	Mar. 18	Apr. 12				
26	do	38	45	325	S. & E.	Loam	1903	10	Mar. 28	Mar. 31	Apr. 5			June 20	July 1	Oct. 25

Phenological records—Peaches—Continued.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds began to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		AMSDEN.													
		° ′													
49	South Carolina	34 50	1,000	E.	Cecil clay	1902	10	Mar. 25	Apr. 5	Mar. 20	Mar. 29	Aug. 25	June 15	June 20	Nov. 28
49	....do	34 50	1,000	E.	....do	1903	12	....do	Apr. 2	Apr. 26	Mar. 21	July 30	June 20	July 1	Nov. 14
38	North Carolina	35 25	2,128	None.	Porous loam	1902	6	Apr. 10	Apr. 17	Apr. 5	Apr. 21	July 6	June 22	June 30	Oct. 15
30	Virginia	38 55	800	N. & E.	....do	1902	2	Apr. 15	Apr. 19	Apr. 14	Apr. 18				
		BILYEU.													
		° ′													
50	South Carolina	34 0	500	None.	Sandy loam	1902	3	Mar. 19	Mar. 28	Mar. 19	Mar. 22				
47	....do	34 40	850		Porous clay	1902	12	Mar. 28	Apr. 8	Mar. 21					Nov. 27
49	....do	34 50	1,000	E.	Cecil clay	1902	3	Mar. 27	Apr. 6	Mar. 20	Apr. 1	Aug. 18	Oct. 1	Oct. 6	Nov. 28
49	....do	34 50	1,000	E.	....do	1904	5	Mar. 22	Mar. 31	Apr. 26	Mar. 21	July 30	Oct. 25	Nov. 15	Nov. 14
32	North Carolina	35 30	2,800	E.	Black loam	1904	8	Apr. 1	Apr. 7	Apr. 20	Apr. 2	Aug. 12	Sept. 28	Oct. 5	Oct. 14
5	Virginia	37 25	1,000	N. & W.	Cecil clay	1903	7	Mar. 23	Mar. 30	Apr. 5	Mar. 28				Oct. 30
16	....do	38 15	400	NE.	Sandy	1902	7	Apr. 10	Apr. 13	May 3	Apr. 20				Oct. 17
		CARMAN.													
		° ′													
50	South Carolina	34 0	500	None.	Sandy loam	1902	3	Mar. 19	Mar. 28	Mar. 19	Mar. 22				
49	....do	34 50	1,000	E.	Cecil clay	1903	4	Mar. 12	Mar. 19	Mar. 10	Mar. 19	Aug. 14	June 25	July 14	Oct. 25
49	....do	34 50	1,000	E.	....do	1904	5	Mar. 22	Mar. 30	Apr. 26	Mar. 21	July 21	July 1	July 15	Nov. 11
2	Virginia	38 5	900	None.	....do	1902	3	Apr. 3	Apr. 11	Apr. 3	Apr. 3				Oct. —
		CHAMPION.													
		° ′													
50	South Carolina	34 0	500	None.	Sandy loam	1902	....	Mar. 17	Mar. 21	Mar. 19	Mar. 21				
11	Virginia	37 25	1,400	NW.	Porous clay	1902	5	Apr. 16	Apr. 19	Apr. 8	Apr. 21	July —	Aug. 15	Aug. 30	

CHINESE CLING.

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62	Georgia	32	5	450	S.	Sandy	1902	7	Mar. 15	Mar. 18	Feb. 27	Apr. 3	...	July 10	July 18	Nov. 20
62	do	32	5	450	S.	do	1903	8	Mar. 6	Mar. 12	Feb. 17	Apr. 2	June 1	July 6	do	Nov. 10
44	South Carolina	33	30	500	W. & N.	Light sandy	1902	5	Mar. 15	Mar. 21	Mar. 25	...	...	...	...	
50	do	34	0	500	None.	Sandy loam	1902	9	Mar. 18	Mar. 23	Mar. 19	Mar. 23	...	...	...	
40	North Carolina	34	15	10	S.	do	1903	5	Mar. 8	Mar. 20	Feb. 22	Apr. 2	Sept. 1	July 15	...	Oct. 28
57	Georgia	34	25	900	SE.	do	1903	8	do	Mar. 15	...	Mar. 23	...	...	...	
47	South Carolina	34	40	850	...	Light clay	1902	12	Mar. 24	Mar. 31	Mar. 21	...	...	July 20	Aug. 8	Nov. 27
49	do	34	50	1,000	E.	Cecil clay	1902	10	Mar. 27	Apr. 3	Mar. 20	Mar. 26	Aug. 20	do	Aug. 1	Nov. 28
49	do	34	50	1,000	E.	do	1903	11	Mar. 11	Mar. 18	Mar. 10	Mar. 14	Aug. 14	July 25	Aug. 15	Oct. 25
49	do	34	50	1,000	E.	do	1904	12	Mar. 21	Mar. 30	Apr. 26	Mar. 19	July 28	July 28	do	Nov. 14
32	North Carolina	35	30	2,800	E.	Black loam	1904	8	Apr. 4	Apr. 12	Apr. 20	Apr. 7	Aug. 15	Aug. 12	Aug. 17	Oct. 14
31	do	35	35	2,300	S.	Red clay	1902	5	Apr. 11	Apr. 18	Apr. 18	Apr. 22	June 25	Aug. 25	Sept. 15	Oct. 15
31	do	35	35	2,300	S.	do	1904	7	Apr. 6	...	Apr. 20	Apr. 10	...	...	...	Do.
4	Virginia	37	15	1,000	None.	Sandy loam	1903	5	Mar. 25	Apr. 1	...	...	...	Aug. 5	Aug. 9	

CONNETT.

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49	South Carolina	34	50	1,000	E.	Cecil clay	1902	3	Mar. 25	Apr. 2	Mar. 20	Mar. 31	Aug. 20	June 15	June 25	Nov. 28
49	do	34	50	1,000	E.	do	1903	4	Mar. 14	Mar. 21	Mar. 10	Mar. 14	Aug. 14	June 25	July 5	Oct. 25
49	do	34	50	1,000	E.	do	1904	5	Mar. 23	Mar. 31	Apr. 26	Mar. 19	Aug. 25	July 1	July 15	Nov. 14
28	Virginia	37	20	1,200	W.	Light clay	1902	4	Apr 6	Apr. 18	...	Apr. 16	...	...	...	
9	do	37	25	1,100	SE.	Red clay	1902	...	Apr. 8	do	Mar. 15	...	...	...	...	
14	do	38	30	400	N.	do	1902	5	Apr. 13	Apr. 20	Apr. 15	Apr. 15	Aug. 22	July 16	July 28	Oct. 22
14	do	38	30	400	N.	do	1903	6	...	Mar. 31	Apr. 5	...	Aug. 12	July 6	July 22	Oct. 18
14	do	38	30	400	N.	do	1904	7	Apr. 15	Apr. 21	Apr. 23	Apr. 10	July 17	...	...	Sept. 23

CROSBY.

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36	North Carolina	35	30	2,850	NW.	Clay loam	1902	5	Mar. 29	Apr. 7	Mar. 25	Apr. 20	July 29	Aug. 25	Sept. 5	Oct. 10
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 22	Mar. 25	Apr. 5	Mar. 25	...	...	...	Oct. 27
12	do	37	0	5	SW.	do	1904	8	Apr. 5	Apr. 10	Apr. 20	Apr. 3	Aug. 10	July 20	...	Oct. 17
5	do	37	25	1,000	N. & W.	Cecil clay	1903	7	Mar. 23	Mar. 30	Apr. 5	Mar. 28	...	...	Aug. 20	Oct. 30
5	do	37	25	1,000	N. & W.	do	1904	8	Apr. 8	Apr. 16	Apr. 22	...	...	...	...	

Phenological records—Peaches—Continued.

EARLY CRAWFORD.

Observer's number.	State.	Approximate latitude.		Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		°	′													
63	Georgia	31	40	450	N.	Sandy loam	1902	5	Mar. 9	Mar. 20	Mar. 19	Mar. 11	....	July 10	July 28	Nov. 28
62	....do	32	5	450	S.	....do	1902	4	Mar. 18	Mar. 21	Feb. 27	Mar. 28	May 20	June 30	July 3	Nov. 20
62	....do	32	5	450	S.	....do	1903	5	Mar. 14	Mar. 20	Feb. 17	Apr. 1	....	....	July 10	Nov. 10
45	South Carolina	33	25	350	E.	Sandy	1903	6	Mar. 10	Mar. 18	Mar. 11	....	July 8	July 5	July 20	Oct. 24
45	....do	33	25	350	E.	....do	1904	7	Mar. 8	....do	Apr. 5	....	June 20	July 7	July 24	Oct. 16
44	....do	33	30	500	W. & N.	....do	1902	8	Mar. 15	Mar. 21	....	Mar. 24	....	....	....	
61	Georgia	34	5	1,540	None.	Clay loam	1902	3	Mar. 22	Apr. 2	....	....	....	July 12	July 30	
47	South Carolina	34	40	850	....	Porous clay	1902	12	Mar. 25	Apr. 4	Mar. 21	....	....	Aug. 2	Aug. 23	Nov. 2
41	North Carolina	35	15	1,700	E.	Black loam	1902	7	Mar. 26	Apr. 2	Mar. 19	Apr. 3	....	....	....	Dec. —
41	....do	35	15	1,700	E.	....do	1903	8	Mar. 13	Mar. 23	Feb. —	....	....	....	....	
38	....do	35	25	2,128	W.	Porous loam	1902	8	Apr. 10	Apr. 17	Apr. 5	Apr. 20	July 10	Aug. 8	Aug. 12	Oct. 15
38	....do	35	25	2,128	W.	....do	1903	9	Mar. 26	Apr. 2	Apr. 6	....	....	....	....	
38	....do	35	25	2,128	W.	....do	1904	10	Apr. 8	Apr. 14	Apr. 11	Apr. 16	July 14	....	....	Do.
36	....do	35	30	2,850	NW.	Clay loam	1902	5	Mar. 31	Apr. 6	Mar. 25	Apr. 17	July 25	Aug. 20	Sept. 1	Oct. 10
36	....do	35	30	2,850	NW.	....do	1903	6	Mar. 15	Mar. 24	Apr. 28	Mar. 20	July 10	....	....	Oct. 15
36	....do	35	30	2,850	NW.	....do	1904	7	Mar. 22	Mar. 25	Apr. 1	Apr. 4	June 20	Aug. 20	Aug. 30	Oct. 16
32	....do	35	30	2,800	E.	Black loam	1904	8	Apr. 1	Apr. 11	Apr. 20	....do	Aug. 15	Aug. 5	Aug. 12	Oct. 14
31	....do	35	35	2,300	S.	Red clay	1902	5	Apr. 11	Apr. 19	Apr. 18	Apr. 21	June 25	....do	Aug. 10	Oct. 15
31	....do	35	35	2,300	S.	....do	1904	7	Apr. 3	....	Apr. 20	Apr. 10	July 1	....	....	Do.
42	....do	36	10	3,250	S.	Black loam	1904	2	Apr. 24	Apr. 27	Apr. 21	May 5	Aug. 4	Aug. 7	Aug. 8	Do.
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 22	Mar. 25	Apr. 5	Mar. 25	July 24	July 24	July 30	Oct. 27
12	....do	37	0	5	SW.	....do	1904	8	Apr. 3	Apr. 10	Apr. 20	Apr. 4	Aug. 2	July 28	Aug. 15	Oct. 17
11	....do	37	25	1,400	NW.	Porous clay	1902	5	Apr. 17	Apr. 19	Apr. 8	Apr. 19	July —	Aug. 1	....do	
27	....do	37	55	200	S.	Sandy loam	1902	15	Apr. 10	Apr. 18	Apr. 9	Apr. 25	....	....do	Aug. 25	Oct. 30
27	....do	37	55	200	S.	Sandy loam	1903	16	Mar. 24	Apr. 1	....	....	....	Aug. 1	Aug. 20	
27	....do	37	55	200	S.	....do	1904	17	Apr. 15	Apr. 23	Apr. 6	Apr. 20	....	Aug. 5	Aug. 25	Sept. 7
16	....do	38	15	400	NE.	....do	1902	5	Apr. 4	Apr. 8	May 3	Apr. 17	....	....	....	Oct. 17
14	....do	38	30	400	N.	Red clay	1903	13	....	Mar. 24	Apr. 5	....	July 29	....	Aug. 16	Oct. 18
26	....do	38	45	325	S. & E.	Loam	1903	9	Mar. 26	Mar. 30	....do	Apr. 10	....	Aug. 1	Aug. 5	Oct. 25
30	....do	38	55	800	N. & E.	Porous loam	1902	4	Apr. 15	Apr. 19	Apr. 14	Apr. 18	....	....	....	

ELBERTA.

		°	'													
60	Georgia	31	25	500	E. & W.	Sandy loam	1902	5	Mar. 8	Mar. 10	Mar. 11	Mar. 13	July 22	July 4	July 23	Nov. 1
60	....do	31	25	500	E. & W.	....do	1903	6	Mar. 5	Mar. 12	Feb. 12	Mar. 10	July 15	June 29	July 3	Nov. 19
60	....do	31	25	500	E. & W.	....do	1904	7	Feb. 26	Mar. 2	Feb. 13	Mar. 1	July 1	June 27	July 9	Oct. 22
63	....do	31	40	450	N.	....do	1902	5	Mar. 3	Mar. 16	Mar. 19	Mar. 5		July 5	July 24	Nov. 28
63	....do	31	40	450	N.	....do	1903	6	...do...	Mar. 15	Feb. 17					Nov. 14
62	....do	32	5	450	S.	....do	1902	8	Mar. 14	Mar. 18	Feb. 27	Mar. 23		July 9	July 23	Nov. 20
62	....do	32	5	450	S.	....do	1903	9	Mar. 7	Mar. 15	Feb. 17	Mar. 20	May 22	July 1	...do...	Nov. 10
45	South Carolina	33	20	350	E.	Sandy	1902	4						July 20	July 28	Nov. 28
45	....do	33	20	350	E.	....do	1903	5	Mar. 10	Mar. 20	Mar. 11		July 10	July 4	July 25	Oct. 24
45	....do	33	20	350	E.	....do	1904	6	...do...	Mar. 17	Feb. 5		June 20	July 11	July 26	Oct. 16
44	....do	33	30	500	W. & N.	....do	1902	8	Mar. 17	Mar. 22		Mar. 26				
53	Georgia	33	40	1,000	W.	Clay loam	1903	4	Mar. 10	Mar. 18	Mar. 2					
50	South Carolina	34	0	500	None.	Sandy loam	1902	9	Mar. 16	Mar. 21	Mar. 19	Mar. 22		July 10	July 27	
54	Georgia	34	0	700	S.	Cecil clay	1904	8	Mar. 10	Mar. 19	Apr. 5	Apr. 4	Aug. 8	July 22	Aug. 8	Oct. 22
61	....do	34	5	1,540	None.	Clay loam	1902	3	Mar. 22	Mar. 27				July 15	Aug. 6	
40	North Carolina	34	15	10	S.	Sandy loam	1903	3	Feb. 28	Mar. 10	Feb. 22	Mar. 20	Aug. 28	July 8		Oct. 28
52	Georgia	34	20	1,100		Cecil clay	1904	7	Mar. 17	Mar. 25	Apr. 4	Mar. 14	Aug. 1	July 23	Aug. 3	Nov. 15
57	....do	34	25	900	SE.	Sandy loam	1903	8	Mar. 9	Mar. 16		Mar. 22		July 22	Aug. 1	
59	....do	34	30	1,600	None.	....do	1904	6	Mar. 20	Mar. 25	Apr. 12	Mar. 20	June 20	Aug. 10	Aug. 20	
58	....do	34	40	1,300	N.	Cecil clay	1904		Mar. 13	Mar. 21	Apr. 11	Apr. 27		July 15	Aug. 1	
47	South Carolina	34	40	850		Porous clay	1902	12	Mar. 24	Mar. 29	Mar. 21			July 30	Aug. 12	Nov. 27
46	....do	34	40	900	W.	Cecil clay	1902	4	Mar. 3	Mar. 20		Mar. 27	June 30	Aug. 1	Aug. 15	
49	....do	34	50	1,000	E.	....do	1902	10	Mar. 22	Mar. 31	Mar. 20	Mar. 26	Aug. 24	July 20	Aug. 5	Nov. 28
49	....do	34	50	1,000	E.	....do	1903	11	Mar. 11	Mar. 18	Mar. 10	Mar. 14	Aug. 16	July 25	Aug. 15	Oct. 25
49	....do	34	50	1,000	E.	....do	1904	12	Mar. 18	Mar. 26	Apr. 26	Mar. 17	July 26	July 28	...do...	Nov. 14
51	....do	34	55	700	S. & E.	....do	1902	4	Mar. 16	Apr. 10		Apr. 14		July 6	Aug. 28	
41	North Carolina	35	15	1,700	E.	Black loam	1902	3	Mar. 22	Mar. 27	Mar. 19	Mar. 26				
35	....do	35	30	2,700	N.	....do	1904	12	Mar. 25	Apr. 1		Apr. 8		July 20		
31	....do	35	35	2,300	E.	....do	1902	4	Apr. 5	Apr. 15	Apr. 18	Apr. 18	June 25	Aug. 15	Aug. 20	Oct. 15
31	....do	35	35	2,300	E.	....do	1904	6	Apr. 1	Apr. 8	Apr. 20					Do.
42	....do	36	10	3,250	S.	....do	1904	2	Apr. 24	Apr. 26	Apr. 21	May 1	July 30	July 25		Do.
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 20	Mar. 24	Apr. 5	Mar. 22	July 24	July 29	July 30	Oct. 27
12	....do	37	0	5	SW.	....do	1904	8	Apr. 2	Apr. 10	Apr. 20	Apr. 1	Aug. 12	Aug. 6		Oct. 17
4	....do	37	15	1,000	None.	....do	1902	4	Apr. 1	Apr. 7				Aug. 25	Aug. 29	
4	....do	37	15	1,000	None.	....do	1903	5	Mar. 21	Mar. 27				July 5	July 10	
28	....do	37	20	1,200	N. & W.	Porous clay	1902	4	Apr. 6	Apr. 20		Apr. 12				
5	....do	37	25	1,000	N. & W.	Cecil clay	1903	7	Mar. 21	Mar. 30	Apr. 5	Apr. 28				Oct. 30
5	....do	37	25	1,000	N. & W.	....do	1904	8	Apr. 7	Apr. 15	Apr. 22					
11	....do	37	25	1,400	NW.	Porous clay	1902	5	Apr. 19	Apr. 24	Apr. 8	Apr. 22	July —	Aug. 15	Aug. 30	
2	....do	38	5	900	None.	Cecil clay	1902	9	Apr. 1	Apr. 7	Apr. 3	Apr. 1		Aug. 11	Aug. 15	Oct. —
17	....do	38	15	150	S.	Sandy loam			Mar. 31	Apr. 12	Mar. 18	Apr. 7				
29	....do	38	25	1,500	N. & W.	Porous clay	1902	4	Apr. 12	Apr. 20		Apr. 10		Aug. 18	Sept. 1	
14	....do	38	30	400	N.	Red clay	1902	4	Apr. 10	Apr. 17	Apr. 15	Apr. 11	Aug. 27			Oct. 22
14	....do	38	30	400	N.	....do	1903	5		Mar. 30	Apr. 5		Aug. 15	Aug. 12	Aug. 26	Oct. 18
14	....do	38	30	400	N.	....do	1904	6	Apr. 15	Apr. 19	Apr. 23	Apr. 10	July 15	Aug. 28	Sept. 11	Sept. 23
26	....do	38	45	325	S. & E.	Loam	1903	3	Mar. 23	Mar. 27	Apr. 5	...do...		Aug. 5	Aug. 16	Oct. 25
30	....do	38	55	800	N. & E.	Porous loam	1902	2	Apr. 12	Apr. 16	Apr. 14	Apr. 16		Aug. 15	Aug. 25	

Phenological records—Peaches—Continued.

GLOBE.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		° ′													
61	Georgia	34 5	1,540	None.	Clay loam	1902	3	Mar. 25	Mar. 31				July 30	Aug. 15	
41	North Carolina	35 15	1,700	E.	Black loam	1902	7	Mar. 26	Apr. 2	Apr. 19					
41	do	35 15	1,700	E.	do	1903	8	Mar. 13	Mar. 22						

GREENSBORO.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		° ′													
47	South Carolina	34 40	850		Porous clay	1902	4	Mar. 25	Apr. 2	Mar. 21			June 6	June 25	Nov. 27
49	do	34 50	1,000	E.	Cecil clay	1902	10	Mar. 27	Apr. 4	Mar. 20	Mar. 31	Aug. 16	June 10	June 16	Nov. 28
49	do	34 50	1,000	E.	do	1903	11	Mar. 14	Mar. 21	Mar. 10	Mar. 14	Aug. 9	June 15	July 1	Oct. 25
49	do	34 50	1,000	E.	do	1904	12	Mar. 24	Apr. 1	Apr. 26	Mar. 21	July 29	July 1	July 10	Nov. 14
9	Virginia	37 25	1,000	SE.	Red clay	1902	5	Apr. 6	Apr. 15	Apr. 15					
9	do	37 25	1,000	SE.	do	1903	6	Mar. 15	Mar. 26				June 26	July 15	
11	do	37 25	1,400	NW.	Porous loam	1902	5	Apr. 19	Apr. 22	Apr. 8	Apr. 21	July —	July 15	Aug. 15	
14	do	38 30	400	N.	Red clay	1902	3	Apr. 13	Apr. 18	Apr. 15	Apr. 11	Aug. 22	July 17		Oct. 22
14	do	38 30	400	N.	do	1903	4		Mar. 30	Apr. 5		Aug. 12	July 1	July 10	Oct. 18
14	do	38 30	400	N.	do	1904	5	Apr. 20	Apr. 26	Apr. 23	Apr. 10	July 15			Sept. 23

HEATH CLING.

Observer's number.	State.	Approximate latitude.	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
		° ′													
40	North Carolina	34 15	10	S.	Sandy loam	1902	4	Mar. 10	Mar. 24	Apr. 3	Apr. 14				Nov. 14
47	South Carolina	34 40	850		Clay loam	1902	12	Mar. 28	Apr. 7	Mar. 21			Aug. 28	Sept. 10	Nov. 27
41	North Carolina	35 15	1,700	E.	Black loam	1902	7	Mar. 26	Mar. 31	Mar. 19	Mar. 2				
31	do	35 35	2,300	S.	Red clay	1902	4	Apr. 8	Apr. 15	Apr. 18	Mar. 20	June 25	Aug. 10	Aug. 20	Oct. 15
31	do	35 35	2,300	S.	do	1904	6	Apr. 3	Apr. 10	Apr. 20					Do.
6	Virginia	37 25	1,000	SE.	Cecil clay	1902	5	Apr. 1	do	Mar. 20	Apr. 1	July 1	Sept. 10	Oct. 1	Oct. 20
6	do	37 25	1,000	SE.	do	1903	6	Apr. 10	Apr. 20	Apr. 20	Apr. 10	do	do	do	Oct. 15
27	do	37 55	200	S.	Sandy loam	1902	15	do	Apr. 18	Apr. 9	Apr. 25		Sept. 25	Oct. 15	Oct. 30
2	do	38 15	900	None.	Cecil clay	1902	10	Apr. 9	Apr. 14	Apr. 3	Apr. 9				Oct. —
26	do	38 45	375	SE.	Loam	1903	10	Mar. 23	Mar. 26	Apr. 5	Apr. 14		Sept. 25	Sept. 28	Oct. 25

LATE CRAWFORD.

		°	′													
59	Georgia	34	30	1,600	None.	Sandy loam	1904	6	Mar. 20	Mar. 28	Apr. 12	Mar. 22	June 20	Aug. 15	Aug. 25	
41	North Carolina	35	15	1,700	E.	Black loam	1902	7	Mar. 26	Apr. 2	Mar. 11	Apr. 3			Sept. 15	Oct. 10
36	do	35	30	2,850	NW.	Clay loam	1902	5	Mar. 31	Apr. 10	Mar. 25	Apr. 20	July 26	Sept. 3		Oct. 15
42	do	36	10	3,250	S.	Black loam	1904	2	Apr. 25	Apr. 29	Apr. 21	May 1	Aug. 6			Oct. 17
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 2	Apr. 9	Apr. 20	Apr. 1	Aug. 14			Oct. —
2	do	38	5	900	None.	Cecil clay	1902	5	Apr. 1	Apr. 7	Apr. 3	do		Sept. 7	Sept. 25	
14	do	38	30	400	N.	Red clay	1902	12	Apr. 15	Apr. 21	Apr. 15	Apr. 14	Aug. 25			Oct. 22
14	do	38	30	400	N.	do	1903	13		Apr. 1	Apr. 5		Aug. 15			Oct. 18
14	do	38	30	400	N.	do	1904	14	Apr. 16	Apr. 20	Apr. 23	Mar. 11	July 17			Sept. 23

MOUNTAIN ROSE.

		°	′													
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 22	Mar. 24	Apr. 5	Mar. 24				Oct. 27
12	do	37	0	5	SW.	do	1904	8	Apr. 4		Apr. 20	Apr. 5	Aug. 12	Aug. 2	Aug. 12	Oct. 17
5	do	37	25	1,000	N. & W.	Cecil Clay	1903	7	Mar. 21	Mar. 30	Apr. 5	Mar. 28			Aug. 5	Oct. 30
5	do	37	25	1,000	N. & W.	do	1904	8	Apr. 6	Apr. 16	Apr. 22					
11	do	37	25	1,400	NW.	Porous loam	1902	5	Apr. 16	Apr. 19	Apr. 8	Apr. 21	July —	Aug. 1	Aug. 30	
2	do	38	5	900	None.	Cecil clay	1902	10	Apr. 7	Apr. 12	Apr. 3	Apr. 7				Oct. —
13	do	38	50	300	E. & W.	Sandy	1902	12	Apr. 10		May 30			Aug. 10	Aug. 25	Sept. 18

OLDMIXON.

		°	′													
47	South Carolina	34	40	850		Clay loam	1902	9	Mar. 27	Apr. 5	Mar. 21			Aug. 7	Aug. 27	Nov. 27*
36	North Carolina	35	30	2,850	NW.	do	1902	5	Mar. 31	Apr. 7	Mar. 25	Apr. 16	July 30	Sept. 1	Sept. 10	Oct. 10
36	do	35	30	2,850	NW.	do	1903	6	Mar. 12	Mar. 24	Apr. 28	Mar. 25	July 20			Oct. 15
5	Virginia	37	25	1,000	N. & W.	Cecil clay	1903	7	Mar. 21	Mar. 30	Apr. 5	Mar. 28				Oct. 30
5	do	37	25	1,000	N. & W.	do	1904	8	Apr. 6	Apr. 16	Apr. 22					
27	do	37	55	200	S.	Sandy loam	1902	15	Apr. 10	Apr. 18	Apr. 9	Apr. 25		Aug. 1	Sept. 1	Do.
27	do	37	55	200	S.	do	1903	16	Mar. 24	Apr. 1				Aug. 20	do	Sept. 7
27	do	37	55	200	S.	do	1904	17	Apr. 15	Apr. 23	Apr. 6	Apr. 20		Aug. 25	Sept. 5	
16	do	38	15	400	NE.	Sandy	1902	5	Apr. 10	Apr. 12	May 3	do				Oct. 17
17	do	38	15	150	S.	Sandy loam	1902		Mar. 31	do	Mar. 18	Apr. 7				
26	do	38	45	325	S. & E.	Loam	1903	3	Mar. 23	Mar. 28	Apr. 5	Apr. 10		Aug. 5	Aug. 25	Oct. 25
13	do	38	50	300	E. & W.	Sandy	1902	12	Apr. 13		May 30			Aug. 15	Sept. 10	Sept. 18
30	do	38	55	800	N. & E.	Porous loam	1902	4	Apr. 15	Apr. 20	Apr. 14	Apr. 18		Aug. 10	Aug. 18	

Phenological records—Peaches—Continued.

RIVERS.

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
60	Georgia	31	25	450	E. & W.	Sandy loam	1902	6	Mar. 7	Mar. 16	Mar. 11	Mar. 16	July 28			Nov. 1
62	do	32	5	450	S.	Sandy	1902	6	Mar. 20	Mar. 24	Feb. 27	Apr. 1		June 10	June 20	Nov. 20
62	do	32	5	450	S.	do	1903	7	Mar. 12	Mar. 20	Feb. 17	Apr. 3	May 25	June 20	June 25	Nov. 10
45	South Carolina	33	25	350	E.	do	1903	5	Mar. 10	Mar. 15	Mar. 11		July 1	June 5	June 20	Oct. 24
45	do	33	25	350	E.	do	1904	6	Mar. 11	Mar. 17	Apr. 5		June 20	June 9	June 24	Oct. 16
61	Georgia	34	5	1,540	None.	Clay loam	1902	3	Mar. 24	Mar. 31				June 17	July 1	
47	South Carolina	34	40	850		do	1902	12	Mar. 27	Apr. 4	Mar. 21			June 27	July 9	Nov. 27
49	do	34	50	1,000	E.	Cecil clay	1903	11	Mar. 14	Mar. 21	Mar. 10	Mar. 18	Aug. 9	June 10	June 20	Oct. 25
41	North Carolina	35	15	1,700	E.	Black loam	1902	7	Mar. 27	Apr. 2	Mar. 19	Apr. 1				
41	do	35	15	1,700	E.	do	1903	8	Mar. 19	Mar. 25	Feb. —					
38	do	35	25	2,128	W.	Porous loam	1902	8	Apr. 12	Apr. 20	Apr. 5	Apr. 24	July 8	July 12	July 22	Oct. 15
12	Virginia	37	0	5	SW.	Sandy loam	1903	7	Mar. 23	Mar. 26	do	Apr. 5	Aug. 12	July 14	July 20	Oct. 27
12	do	37	0	5	SW.	do	1904	8	Apr. 5	Apr. 9	Apr. 20					Oct. 17
5	do	37	25	1,000	N. & W.	Cecil clay	1903	3	Mar. 21	Mar. 30	Apr. 5				July 10	Oct. 30
2	do	38	5	900	None.	do	1902	5	Apr. 1	Apr. 7	Apr. 3	Apr. 1				Oct. —
26	do	38	45	325	S. & E.	Loam	1903	8	Mar. 22	Mar. 28	Apr. 5			July 4	July 12	Oct. 25

ST. JOHN.

Observer's number.	State.	Approximate latitude. °	′	Elevation (feet).	Slope.	Soil.	Year.	Age of tree (years).	Date first bloom.	Date full bloom.	Date last spring frost.	Date leaf buds begin to open.	Date terminal buds begin to form.	Date first picking.	Date last picking.	Date first fall frost.
60	Georgia	31	25	450	E. & W.	Sandy loam	1902	6	Mar. 9	Mar. 20	Mar. 11	Mar. 13	July 25			Nov. 1
49	South Carolina	34	50	1,000	E.	Cecil clay	1903	3	Mar. 16	Mar. 23	Mar. 10	Mar. 16	Aug. 11	July 10	July 23	Oct. 25
49	do	34	50	1,000	E.	do	1904	4	Mar. 18	Mar. 27	Apr. 26	Mar. 17	July 24	July 20	July 30	Nov. 14
41	North Carolina	35	15	1,700	E.	Black loam	1902	7	Mar. 26	Apr. 2	Mar. 19	Apr. 2				
41	do	35	15	1,700	E.	do	1903	8	Mar. 17	Mar. 23	Feb. —					

SALWAY.

		°	′													
61	Georgia	34	5	540	None.	Clay loam	1902	3	Mar. 23	Mar. 29	...	...	...	Aug. 29	Sept. 15	
49	South Carolina	34	50	1,000	E.	Cecil clay	1902	3	Mar. 27	Apr. 6	Mar. 28	Apr. 2	Aug. 17	Sept. 9	Oct. 1	Nov. 28
49	....do	34	50	1,000	E.	....do	1903	4	Mar. 16	Mar. 23	Mar. 10	May 19	Aug. 9	Sept. 15	Sept. 25	Oct. 25
49	....do	34	50	1,000	E.	....do	1904	5	Mar. 21	Apr. 1	Apr. 26	Mar. 19	July 28	Sept. 1	Sept. 15	Nov. 14
9	Virginia	37	25	1,100	SE.	Red clay	1902	...	Apr. 10	Apr. 20	Mar. 15					
5	....do	37	25	1,000	N. & W.	Cecil clay	1903	3	Mar. 23	Mar. 30	Apr. 5	...	...	...	Sept. 10	Oct. 30
14	....do	38	30	400	N.	Red clay	1902	4	Apr. 12	Apr. 20	Apr. 15	Apr. 14	Aug. 21	Aug. 18	Aug. 26	Oct. 22
14	....do	38	30	400	N.	....do	1903	5	...	Apr. 1	Apr. 5	...	Aug. 15	Aug. 12	Aug. 29	Oct. 18
14	....do	38	30	400	N.	....do	1904	6	Apr. 16	Apr. 21	Apr. 23	Apr. 10	July 22	Aug. 26	Sept. 14	Sept. 23

SMOCK.

		°	′													
47	South Carolina	34	40	850	...	Clay loam	1902	...	Mar. 27	Apr. 3	Mar. 21	...	...	Aug. 20	Sept. 10	Nov. 27
32	North Carolina	35	30	2,800	E.	Black loam	1904	...	Apr. 1	Apr. 9	Apr. 20	Apr. 2	Aug. 12	...	...	Nov. 14
12	Virginia	37	0	5	SW.	Sandy loam	1904	8	Apr. 5	Apr. 12	Apr. 20	Apr. 6	Aug. 16	...	...	Oct. 17
16	....do	38	15	400	NE.	Sandy	1902	7	Apr. 8	Apr. 11	May 3	Apr. 20	...	...	...	Do.
26	....do	38	45	325	S. & E.	Loam	1903	10	Mar. 23	Mar. 28	Apr. 5	Apr. 12	...	Sept. 3	Sept. 10	Oct. 25

STUMP.

		°	′													
44	South Carolina	33	30	500	W. & N.	Sandy	1902	8	Mar. 15	Mar. 20	Mar. 22	...	...	...	...	
54	Georgia	34	5	700	S.	Cecil clay	1904	8	Mar. 12	....do	Apr. 5	Mar. 8	Aug. 15	Aug. 8	Aug. 20	Oct. 22
47	South Carolina	34	40	850	...	Clay loam	1902	12	Mar. 24	Mar. 30	Mar. 21	...	...	July 20	Aug. 5	Nov. 27
32	North Carolina	35	30	2,800	E.	Black loam	1904	8	Apr. 7	Apr. 11	Apr. 20	Apr. 4	Aug. 15	Sept. 10	...	Oct. 14
31	....do	35	35	2,300	S.	Red clay	1902	4	Apr. 11	Apr. 19	Apr. 18	Apr. 21	June 25	Aug. 15	Aug. 28	Oct. 15
31	....do	35	35	2,300	S.	....do	1904	6	Apr. 3	...	Apr. 20	Apr. 10	...	...	...	Do.
42	....do	36	10	3,250	S.	Black loam	1904	2	Apr. 24	Apr. 28	Apr. 21	May 4	July 25	...	...	Do.
27	....do	37	55	200	S.	Sandy loam	1902	15	Apr. 10	Apr. 18	Apr. 9	Apr. 25	...	Aug. 1	Sept. 1	Oct. 30
27	....do	37	55	200	S.	....do	1903	16	Mar. 24	Apr. 1	...	...	...	Sept. 1	Sept. 20	
27	....do	37	55	200	S.	....do	1904	17	Apr. 15	Apr. 20	Apr. 6	Apr. 20	...	Sept. 5	Sept. 25	Sept. 7
16	....do	38	15	400	NE.	Sandy	1902	5	Apr. 7	Apr. 10	May 3	Apr. 18	...	...	...	Oct. 17
17	....do	38	15	150	S.	Sandy loam	1902	...	Mar. 31	Apr. 12	Mar. 18	Apr. 7	...	...	...	
26	....do	38	45	325	S. & E.	Loam	1903	10	Mar. 26	Mar. 29	Apr. 5	Apr. 10	...	Aug. 8	Aug. 12	Oct. 25
13	Virginia	38	50	300	E. & W.	Sandy	1902	13	Apr. 10	...	May 30	...	...	Aug. 20	Sept. 10	Sept. 18
30	....do	38	55	800	N. & E.	Porous loam	1902	4	Apr. 12	Apr. 18	Apr. 14	Apr. 17	...	Aug. 10	Aug. 18	

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.*—A typical mountain apple orchard located on the northeast slope of Sharp Peak (Peaks of Otter), Virginia. This orchard contains many Yellow Newtown trees. Elevation, about 2,300 feet; soil, Porters black loam.

PLATE II. Fig. 1.—Country characteristic of the Piedmont region, Virginia, showing the rolling character of the land. Young apple orchard at the right, Peaks of Otter at the left. Elevation, 1,000 feet; soil, Cecil clay. Fig. 2.—A young interplanted peach and apple orchard, Amherst County, Va., in the Piedmont region. Located at the base and on the lower slopes of a spur of the Blue Ridge.

PLATE III. Fig. 1.—A detached knob of the Blue Ridge on which are located profitable orchards of Yellow Newtown apples and Bilyeu peaches. A desirable location for these varieties. Fig. 2.—Lower portion of a "cove" orchard, Albemarle County, Va., looking down the cove.

PLATE IV.—Relief map showing a portion of the Piedmont region adjacent to the Blue Ridge, the Blue Ridge region south of a point in that region in proximity to Charlottesville, Va., and other contiguous areas not included in the present paper. (Original modeled by E. E. Howell and negative of same loaned by him to this Department.)

PLATE V.—Map showing the pomological regions of Virginia and the South Atlantic States. Section of map indicated by lighter horizontal hatching represents elevation from sea level to 500 feet; mostly Coastal Plain. Section indicated by heavier diagonal hatching represents elevations from about 500 feet to 1,500 feet, except in Virginia north of the Roanoke River, where the extreme elevation is 1,000 feet; nearly all Piedmont region. Vertical hatching represents elevations from 1,500 feet, except in Virginia as noted above, to 4,000 feet; Blue Ridge region. Lighter diagonal hatching represents elevations from about 1,500 feet to 4,000 feet; Allegheny and Cumberland plateaus. Solid green areas, elevations exceeding 4,000 feet. Heavier horizontal hatching, elevations from about 500 to 1,500 feet; valley regions. (Base map, section from contour map, by United States Geological Survey.)

FIG. 1.—COUNTRY CHARACTERISTIC OF THE PIEDMONT REGION, VIRGINIA. THE PEAKS OF OTTER IN THE BACKGROUND.

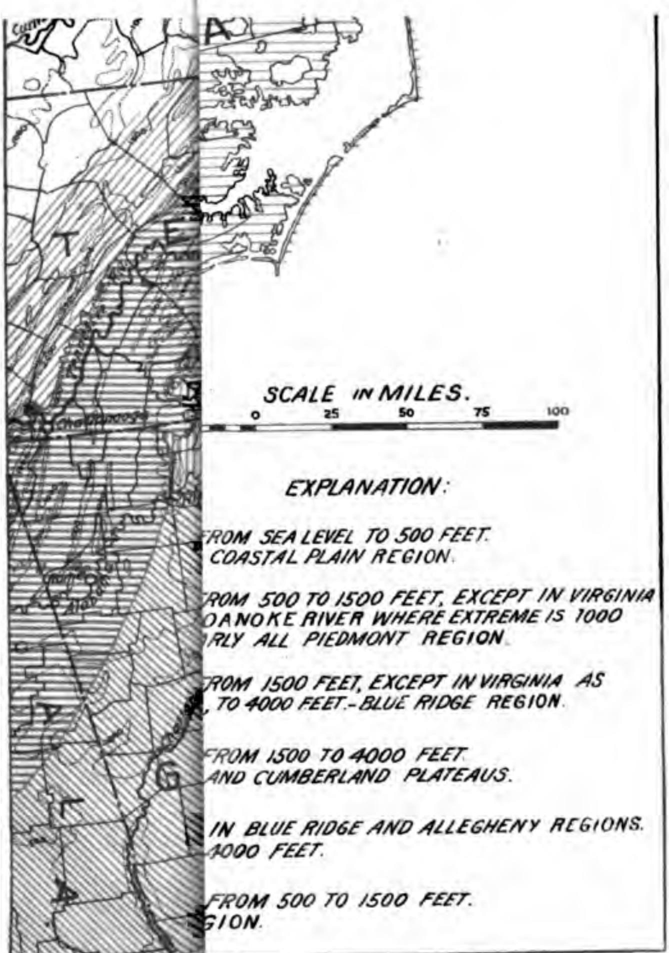
FIG. 2.—A YOUNG INTERPLANTED PEACH AND APPLE ORCHARD AT THE BASE OF TOBACCO ROW MOUNTAIN, AMHERST COUNTY, VA., IN THE PIEDMONT REGION.

FIG. 1.—A DETACHED KNOB OF THE BLUE RIDGE IN VIRGINIA, SHOWING A CHARACTERISTIC ORCHARD LOCATION.

FIG. 2.—LOWER PORTION OF A COVE ORCHARD, ALBEMARLE COUNTY, VA.

RELIEF MAP SHOWING A PORTION OF THE PIEDMONT AND BLUE RIDGE REGIONS OF THE SOUTH ATLANTIC STATES.

[Photographed from a model by Howell.]



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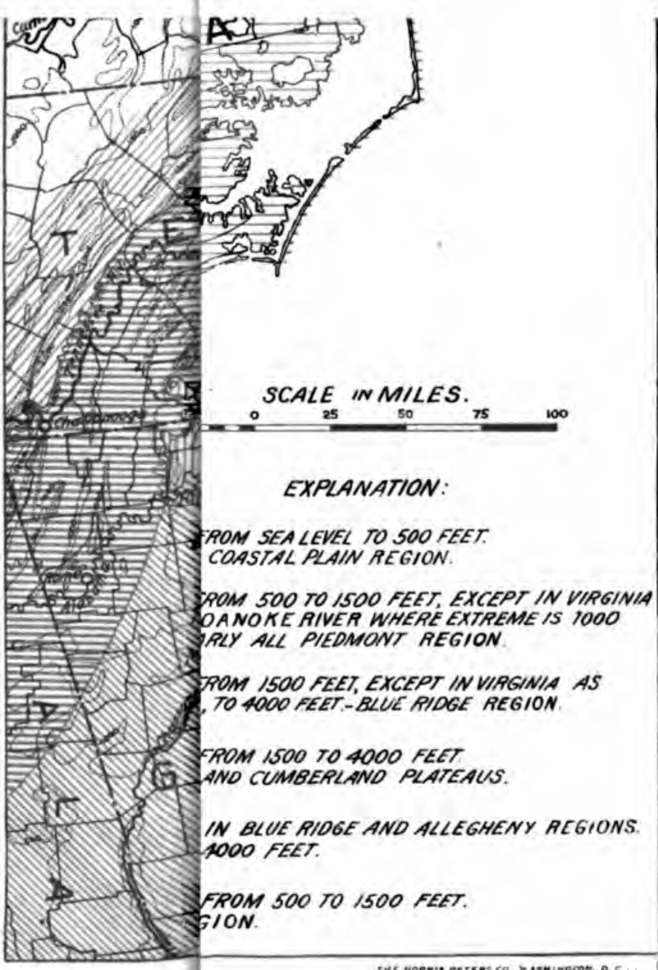
SCALE IN MILES.
0 25 50 75 100
EXPLANATION:
FROM SEA LEVEL TO 500 FEET.
COASTAL PLAIN REGION.
ROM 500 TO 1500 FEET, EXCEPT IN VIRGINIA
OANOKE RIVER WHERE EXTREME IS 1000
RLY ALL PIEDMONT REGION.
ROM 1500 FEET, EXCEPT IN VIRGINIA AS
, TO 4000 FEET.-BLUE RIDGE REGION.
FROM 1500 TO 4000 FEET.
AND CUMBERLAND PLATEAUS.
IN BLUE RIDGE AND ALLEGHENY REGIONS.
4000 FEET.
FROM 500 TO 1500 FEET.
GION.
Chattanooga

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[In the case of synonyms the names are distinguished from the leading varietal names by the use of italic type.]

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 136.

B. T. GALLOWAY, *Chief of Bureau.*

METHODS AND CAUSES OF EVOLUTION.

BY

O. F. COOK,

BIONOMIST, BUREAU OF PLANT INDUSTRY.

ISSUED OCTOBER 31, 1908.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., July 30, 1908.

Sir: I have the honor to transmit herewith a paper entitled "Methods and Causes of Evolution," by Mr. O. F. Cook, of this Bureau, and recommend its publication as Bulletin No. 136 of the Bureau series.

The doctrine of evolution is now being made of practical use in the solution of problems of breeding and acclimatization. The nature of evolution must be understood before the effects of selection and environment upon the characters of organisms can be correctly appreciated as a guide in our efforts to improve plants or to avoid the degeneration which appears in many of our domesticated varieties. The distinctions made in this paper will assist in the practical application of the ascertained facts of evolution, and will help to avoid confusion from numerous conflicting theories which have been developed without bringing evolution into relation with the physiology of plants.

The accompanying report contains a brief statement of the present status of our knowledge of these important subjects, particularly on the sides relating to agriculture. It summarizes in direct and simple form the results of more detailed studies already published by this Department and in scientific journals.

The author wishes to acknowledge helpful criticisms from Prof. Willet M. Hays and from several of his colleagues, Messrs. Walter T. Swingle, T. H. Kearney, W. R. Maxon, Frederick V. Coville, C. S. Scofield, and David Fairchild. The paper has also been read by Dr. Alexander Graham Bell, who has made the following significant comments regarding the function of natural selection:

> I, too, entertain the feeling that natural selection does not, and can not, produce new species or varieties, or cause modifications of living organisms to come into existence. On the contrary, its sole function is to prevent evolution. In its action it is destructive merely, not constructive—causing death and extinction, not life and progression. Death can not produce life; and though natural selection may cause the

death of the unfit, it can not produce the fit—far less evolve the fittest. It may permit the fit to survive by not killing them off if they are already in existence; but it does not bring them into existence or cause improvement in them after they have once appeared. We must look to other agencies for the causes of evolution. A closed gate may block a road, but it does not push the traveler into a new path, or. indeed, cause him to move at all. It is a mere static obstruction, not a dynamic force. In a similar manner natural selection prevents evolution along certain lines; but it is not a dynamic force compelling progress along other lines. The motive power of evolution must be sought elsewhere.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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METHODS AND CAUSES OF EVOLUTION.

INTRODUCTION.

Evolution is the branch of science concerned with the study of organic change. That species are subject to change is a fact as general and as fundamental in the organic world as gravitation is in the inorganic, and no less important in its relations to human progress. Our knowledge of evolution is far from complete, but it affords our only insight into many important problems.

The further development of the art of agriculture by which we live and even the progress of the human race itself are dependent upon knowledge of the conditions and factors which bring about changes in organisms. Our attempts to ameliorate varieties or to avoid degeneration are experiments in evolution. To know how species have developed in nature affords a necessary basis of judgment in the investigation of methods of improvement of domesticated types.

The problem of evolution is not to be solved without understanding how species are constituted, since it is only in species that evolution is known to take place. The higher plants and animals maintain their existence in nature not as separate individuals or in small, isolated groups, but as large groups of freely interbreeding individuals—the groups we call species. The lines of descent of a normal species are united by free interbreeding into a vast network or fabric in which progressive variations are accumulated and built up into new organs and functions. This constructive process also bears the name evolution.

The members of species are not normally uniform, but are normally diverse. Continuous interbreeding among the diverse members of a species is accompanied by continuous changes in the group as a whole, though without diminishing the normal diversity of descent. The more advanced the evolution of a group the greater are the diversities found among the members of the same species.

Natural selection and other agencies of the environment have not been found to cause the evolution of species. After fifty years of

study of evolution it is becoming apparent that constructive evolutionary changes are spontaneously put forth by species, which tend to these evolutionary motions as naturally as inanimate objects tend to remain at rest. Too much emphasis has been laid upon evolution as a process of formation of new species and too little upon evolution as a process of change in species already formed.

Species are multiplied by the subdivision of older species, but evolution goes on whether species are subdivided or not. If two parts of a species become separated the two groups no longer share the new characters which may be attained by each, and thus gradually become different. This occurs even under apparently identical natural conditions, in neighboring islands, mountains, or valleys. Facilities for interbreeding are necessary to keep the same characters distributed throughout a specific group. The formation of more species is one of the results of evolution, but is not a cause of evolution. Evolution and species-formation are different problems.[a]

The recognition of evolution as a property inherent in all species of plants and animals opens the way to the solution of many practical problems. It is not necessary that breeders undertake to produce evolutionary changes, for these take place spontaneously without our interference. Our power over evolution is to control and direct, to accelerate, retard, or reverse it. Some of the means of attaining our purposes are already known to us, and the chances of learning others are greatly increased by clear conceptions of the evolutionary facts and relations encountered in the work of the breeder.

Objections which have been urged against mechanical theories of evolution do not hold against the present interpretation of the facts, for selection and other external conditions are not reckoned as primary causes of evolutionary progress. Their functions are regarded as only secondary and directive. The theory that selection causes evolution, notwithstanding its wide popularity, seems not to be well founded. It stands in the way of further progress in evolutionary science and interferes with a full development of the art of breeding.

EVOLUTION PROCEEDS BY CONTINUOUS CHANGES OF CHARACTERS.

To maintain a distinction between methods and causes conduces to clear thinking in evolution. How evolution proceeds is one question; what actuates the motion is another. By treating these two questions separately much confusion of issues may be avoided.

[a] Cook, O. F. Evolution Not the Origin of Species, Popular Science Monthly, 64:445, 1904; republished in the Annual Report of the Smithsonian Institution for 1904 under the title The Evolutionary Significance of Species. See also Factors of Species-Formation, Science, n. s., 23: 506.

Evolution may be considered as a fact, and the modes or methods of evolutionary change may be studied quite apart from any explanation or theory of the cause of evolution. The regular courses of the heavenly bodies are taken as evidence of the fact of gravitation, although the underlying causes still remain unknown.

Darwin ascertained that evolution is accomplished through continuous, gradual changes in the characters of species. He had a wide acquaintance with species in nature and with the facts of variation. He found in the differences between natural groups evidences of gradual evolutionary divergence. He saw that the evolutionary courses of species could be traced from their characters, much as hunters follow animals by their tracks. Those who have a like acquaintance with species in nature find similar facts and accept Darwin's conception of the method of evolution.

Studies of the classification and geographical distribution of wild species have special value in training the judgment in evolutionary matters. The evidence that evolution is accomplished through continuous changes of characters can not be appreciated adequately by those who know plants and animals only as domesticated breeds and have not become acquainted with the similarities, differences, and internal diversities of species in nature.

NATURAL SELECTION UNLIKE ARTIFICIAL SELECTION.

In addition to showing that continuous changes represent the method by which evolution proceeds, Darwin advanced a theory of the cause of evolution—natural selection by environmental agencies. He applied to natural species analogies drawn from domesticated breeds. The selective action of the environment and of the struggle for existence was supposed to interfere for the preservation of useful variants in nature, to keep their new characters from being "swamped" by interbreeding, in the same way that artificial selection is used to preserve the peculiarities of domesticated breeds.

In reality, natural selection is not similar to artificial selection; there is a complete biological opposition. Natural selection eliminates deficient and aberrant individuals, but preserves the species as a great multitude of diverse, broadly interbreeding organisms. Artificial selection disregards the species, but saves some of the aberrant forms and restricts their descent to narrow lines of consanguinity. Nature has been searched in vain for proofs of the origin of new types from selected individuals or from narrowly restricted varieties. Natural selection by preserving a broad network of descent permits a gradual and completely continuous evolution.

Darwin had learned from his studies of classification and geographical distribution that species in general evolve by gradual subdivision and divergence, as branches grow on trees, but the analogies of

artificial selection are not in accord with this idea of complete continuity. They do not lead us to think of trees as having inherent powers of growth, but as growing because they are pruned.[a]

The breeder cuts off all except the most proficient individuals after careful selection among small fluctuating differences. He seeks in this way to obtain the highest and most uniform expression of a particular character, but this artificial specialization of characters in narrow-bred varieties is not the same as the free evolutionary progress of broad-bred natural species.

To keep a few individuals away from the network of descent of their species is not nature's method of evolution. Narrow artificial selection turns its protégés into paths of degeneration. Natural selection does not separate the fittest individuals from others of their kind. It leaves them to interbreed and share their progress with millions of the less proficient. Only the unfit suffer from nature's discrimination. The more prosperous the species the greater the number of interbreeding individuals. Only when species are verging on extinction do they approach the condition of narrow breeding shown in domesticated varieties.

NATURAL SELECTION NOT THE CAUSE OF EVOLUTION.

Darwin retained much of the pre-evolutionary idea that species are normally stationary, and was accordingly led to infer that changes of characters must be brought about through changes of external conditions. Species were not supposed to have an inherent power of making progressive changes without environmental interference or even in spite of it. Variability was recognized, but variations were not thought of as resulting in evolution unless selection interposed. The adaptive fitness of many species to particular environments seemed to indicate that the causes of evolutionary progress were in the environment.

It is the office of natural selection to guide the evolutions of species in directions of fitness to their environments, but not as a cause of evolution, not through any power to actuate the evolutionary motions of species. The influences of selection are more often exerted in holding species back than in carrying them forward. Adaptation is not the whole of evolution, but only a particular kind, a specially directed

[a] "Each new variety or species, when formed, will generally take the place of, and thus exterminate, its less well-fitted parent. This I believe to be the origin of the classification and affinities of organic beings at all times; for organic beings always *seem* to branch and subbranch like the limbs of a tree from a common trunk, the flourishing and diverging twigs destroying the less vigorous—the dead and lost branches rudely representing extinct genera and families."—Darwin, Charles, On the Tendency of Species to Form Varieties, etc. Proceedings of the Linnean Society of London, 1857, p. 53.

form of evolution. If continued variation is assumed, it is to this that the evolutionary progress must be ascribed, not to natural selection. Selection merely limits the directions that progressive variations may take.[a]

A logical fallacy, as well as a biological error, is involved in assuming that the selecting away of a part of a supposedly stationary species would change the characters of the remainder. Only the statistical averages of the survivors of such a species would be shifted, not their evolutionary positions. Selection would leave the surviving members of a group more uniform, but it would not carry them farther on the course of development. Progress toward uniformity means that some of the characters are suppressed instead of new differences being added. Greater uniformity marks an agricultural improvement in a domesticated variety, but is not a measure of evolutionary progress in a natural species.

Some of the most effective evidence of the supposed power of selection to produce changes of characters has been drawn from the phenomena of mimicry among butterflies. Harmless species sometimes show very close resemblance in wing colors to members of other families protected against birds by distasteful secretions. But even mimicry can be understood by recognizing that selection tends to restrict evolution better than by supposing that selection has dragged the mimetic species away from their relatives and painted them with new colors to resemble unrelated types. Likeness exists before differences develop. It is only necessary to suppose that selection has preserved similarities when these were of use, while the related groups have been free to diverge in colors, as in other characters. Mimicry affords striking proof that selection can lead two or more species to evolve in parallel or converging directions, but it does not show that selection is the motive power of evolutionary change.

If species were not already evolving, natural selection would have no influence over them; there would be no motion to be resisted and guided toward greater utility. That selection should not be expected to originate new characters has often been recognized, but it is equally unreasonable to suppose that existing characters would be modified by selection if species were normally stationary. The facts of adaptation abundantly corroborate the Darwinian conception of evolution as a process of gradual change in the characters of species, but they afford no proof at all that selection can cause adaptive variations or carry along the evolutionary progress of species.

Strangely enough, the general popularity of the doctrine of evolution has been due largely to this theory which made selection appear

[a] Cook, O. F. Weevil-Resisting Adaptations of the Cotton Plant. Bulletin 88, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1906.

as the cause of evolution, the side of Darwinism which has been most persistently questioned by students of nature. Many intelligent people think they can see clearly that natural selection, working through variability, causes species to evolve, but among biologists this has continued to appear doubtful. The scientific literature of the last half century abounds in protests declaring that the alleged cause is inadequate and the reasoning inconsistent with the facts.

Philosophical writers found in natural selection an extremely attractive hypothesis which made the organic world a result of its environment. Those who are not deterred by the biological difficulties begin by accepting natural selection as the cause of evolution, and then argue that the changes are continuous because they are results of continuous selection. This is to reverse Darwin's method of reasoning, for he used the facts of gradual evolution to support the theory of selection. The withdrawal of the theory of selection does not weaken the doctrine of continuity, but leaves it the more firmly established.

Darwin's first concern was not to demonstrate the theory of natural selection, but to implant in the minds of his readers the general conception of organic evolution. He made free use of any facts, suggestions, or theories that seemed likely to aid in establishing the basic idea of evolution. Many of his readers could understand the argument for natural selection as a cause of evolution, while very few could appreciate the mass of detailed evidence proving the more fundamental fact that the changes of characters are gradual and continuous. The theory of selection soon overshadowed the fact of continuity. Darwinism came to mean merely natural selection. Advocates and opponents alike have allowed themselves to forget that Darwin's perception of the method of evolution was independent of his theory of cause.

THE SIGNIFICANCE OF USELESS CHARACTERS.

Useless characters have more bearing than useful characters upon the question of evolutionary methods and causes. No interpretation is adequate that does not provide for the evolution of useless characters. If useless differences can be evolved without selection, the same may be expected for useful differences. To suppose that selection is the cause of evolution no longer appears necessary.

The theory of selection requires us to believe in the utility of all characters and in the development of each character through the selective origination of a new species. Darwin appreciated the difficulties of his hypothesis and continued all his life to seek additional evidence. Many other naturalists have joined in the search, and a large literature of adaptations has accumulated. New and

interesting uses of many characters have been discovered, but the results do not support the assumption of utility for all characters. The examination of any group of species or genera shows that the useless differences vastly outnumber those for which any environmental use can be assigned or even imagined.

Possibilities of former utility in characters now useless may be admitted, but the preponderance of useless differences is far too great to be thus explained away. The issue is not so plain among the complex structures and diverse habits of the higher animals and plants. Conclusive evidence comes from the lower orders, where many species and genera have the same habits and live under the same conditions and yet display endless differences of form and structure. There may still be doubt regarding the present or past utility of any particular character, but there can be no question that diversities of characters are out of all proportion to selective diversities of environment.[a]

A useful character has an evolutionary advantage, for it can develop and spread through the species without being hindered by the natural selection which discriminates against useless and injurious characters. Any change not forbidden by the limiting factors of environment and competition can go on by mere evolutionary propensity. The evolutionary progress of a useful character is no less spontaneous than that of a useless character. Selection need not be thought of as carrying along the useful character, but only as hindering the development of injurious characters. Selection works through restriction of descent—restriction of evolution.

A species evolving in the direction of longer hair would be able to resist increasing degrees of cold, but it is not necessary to think that the cold causes the longer hair to be evolved. The utility of a new variation depends upon the environment at hand when the variation is put forth. Thus, utility is a consequence of evolution; to say that it is the cause of evolution is to reverse the true relations of the facts. Instead of selection causing the evolution of the useful character, it is the advance of evolution that enables the higher standards of selection to be applied without destroying the species. The evolutionary progress of the species is not a result of selection, but an antecedent condition.

To gain clear perceptions of evolutionary factors we may lay aside this historical assumption that selection is the motive power of evolution, the active principle, agency, or cause by which evolution is brought about. Evolution is to be conceived in the mind as entirely independent and distinct from selection.

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[a] Cook, O. F. Evolutionary Inferences from the Diplopoda. Proc. Entomological Society of Washington, 5: 84. 1902.

ABRUPT VARIATIONS NOT INCOMPATIBLE WITH CONTINUOUS EVOLUTION.

The failure to distinguish adequately between the theory of selection and the fact of gradual change has led some writers to suppose that the idea of continuous evolution must be given up when the theory of selection is rejected. Hence, they return to the older notion of fixity of species and make use of the idea of evolution only to the extent of supposing that new species originate from older species by abrupt transformations of individuals, instead of being created altogether anew. Sudden changes of characters often occur, variously known as "sports," "mutations," or "extraordinary births," and these have been taken as new species and as true examples of the method of evolution.

Abrupt variations in the characters of individuals do not necessarily conflict with the method of evolution as a continuous change in the network of descent of the species. A single sheep may jump the fence, but this does not prove that a new flock is to be formed, for the others usually follow. The motion of the flock would still be gradual, no matter how far the individual sheep might jump. An individual variation, however wide, would not have evolutionary value and permanence unless the new character were able to spread to other members of the species, and thus become established in the network of descent.

A new character is like a new pattern in a fabric. Substitutions among patterns already designed are not to be confused with the working out of new patterns. Sudden alternations among old characters do not compel us to believe that new characters are made suddenly. The facts of continuous change shown in natural species enable us to think of new characters as woven by gradual changes and combinations of older characters through the interweaving of the lines of descent of the species.

REVERSION, MUTATION, AND MENDELISM.

A narrow-bred uniform variety shows only one set of characters, so that the characters of a diverse individual mutant appear to be new. But if we observe a sufficient series of mutations as they spring from the same uniform variety, a wide range of individual diversity is found, like that of the wild species from which our cultivated varieties are derived. It becomes evident that selective narrow breeding has not destroyed the ancestral diversities, but only suppressed them. Though showing only one set of characters in its external visible form, the narrow-bred variety still transmits a long series of latent differences.[a]

[a] Cook, O. F. Heredity Related to Memory and Instinct. The Monist, 18: 363. 1908.

To ascertain that an individual plant or animal has brought a really new character into expression it would be necessary to have a complete account of its ancestry, to know all the characters which are being transmitted along the lines of descent. Such knowledge is not to be obtained from the pedigrees of a few generations of narrow-bred individuals. The wild species gives the best idea of the normal diversity of ancestral characters. When the wild species no longer exists our only resource is to apply the analogies of diversity shown in other related wild types.

The ranges of diversity shown in wild species are not equal, but they are generally very much wider than in narrow-bred domesticated varieties. Thus, aboriginal cotton varieties from Central America, though often as well isolated and as distinct from each other as natural species, have an individual diversity corresponding to that of our whole series of varieties of Upland cottons and even greater. The mutative variations of our Upland varieties often show some of the forms of diversity which are regularly present in the Central American series, but are not represented in any of the Upland varieties now cultivated in the United States.

The sudden mutative changes in our Upland cottons which fall outside the range of diversity of the Central American types are in the nature of abnormalities, such as the shortening of joints, fasciation of branches and flowers, and partial or complete absence of lint. Such a degeneration does not constitute a new character in any truly evolutionary sense. It is merely a failure to bring an old character into normal expression.

By hybridizing two narrow-bred varieties we can often recall to expression many of the diverse characters of the aboriginal species—characters which may have been suppressed for so many generations that they appear to us as entirely new. Thus, the characters of mutations and of hybrids may have the same origin in the store of latent diversities which even the most uniform varieties continue to transmit.

Hybridization serves our purposes best in plants grown by vegetative propagation, but mutations are preferable in species grown from seed, because the change of expression is more definitely "fixed" from the first, without the need of the series of selections used for fixing the characters of hybrids, sometimes ineffectually.

Thus, characters which have been supposed to originate suddenly in mutative variations can be viewed with better reason as reversions or as degenerations; often they partake of the nature of both. That the great majority of mutations are obviously abnormal and inferior in fertility, even to the degenerating stocks from which they spring, is a sufficient reason for refusing to regard them as true examples of a constructive evolutionary progress.

Many instances of abrupt variations, or "sports," were known to Darwin, but he considered that sudden changes of characters indicate abnormality. He was too familiar with the evidences of continuous change in natural species to look with favor upon the idea of evolution by sudden jumps from one species to another. The following passages may serve to show his general conclusion regarding the group of facts now commonly described as mutation and Mendelism:

> The ordinary result of a cross is the production of a blended or intermediate form; but in certain cases some of the offspring take closely after one parent-form, and some after the other. This is especially apt to occur when the parents differ in characters which first appeared as sudden variations or monstrosities.[a]
>
> When two breeds are crossed their characters usually become intimately fused together; but some characters refuse to blend and are transmitted in an unmodified state either from both parents or from one.
>
> From this fact, and from the several slight, aggregated differences which distinguish domestic races and species from one another, not being liable to this peculiar form of transmission, we may conclude that it is in some way connected with the sudden appearance of the characters in question.
>
> Some few characters, however, are incapable of fusion, but these are unimportant, as they are often of a semimonstrous nature and have appeared suddenly.[b]

Although the sudden changes and the "peculiar form of transmission" shown in mutative varieties are often connected with abnormalities, other forms of alternative expression of characters are general in nature and must be reckoned as entirely normal. Sexual differences represent a form of alternative expression of characters quite as definite as in the so-called "Mendelian hybrids" in which contrasted parental characters "refuse to blend."

It is a most familiar fact that sexually diverse parents produce sexually diverse offspring, and in equal numbers when averages are considered. Darwin and others have shown that the characters expressed in only one sex are transmitted by both sexes. There is much additional evidence that sexual diversity arises from the unequal expression of alternative characters, not from unequal transmission, and the same interpretation can be applied to all the facts of Mendelism. Considered as a phenomenon of alternative expression, Mendelism finds a place in a connected series of phenomena as one of many forms of diversity which may exist among the members of the same species. The assumptions used to explain Mendelism as a phenomenon of alternative transmission are too complicated to secure

[a] Darwin, Charles. The Descent of Man and Selection in Relation to Sex, New York edition, p. 172. 1896.

[b] Darwin, Charles. The Variation of Animals and Plants Under Domestication, New York edition, pp. 69, 72, and 157. 1897.

credence when the possibility of a simpler interpretation is once appreciated.[a]

ADJUSTMENTS OF CHARACTERS TO EXTERNAL CONDITIONS.

Another form of alternating expression is found in the changes of characters, often very abrupt, by which organisms are able to adjust themselves to different conditions of existence. Before the possibilities of alternative expression were realized, these environmental changes were supposed to represent a power of the environment to form new characters in organisms, a supposition no longer required. The alternative characters of the same species are like the two or more forms which the same chemical substance may take in crystallization.

Environmental changes, like mutations, are to be considered as alternative expressions of characters already developed; they do not represent the progressive changes by which new characters are originated. One alternative character need not be considered more normal than another, seeing that freedom of substitution among many alternative characters is a normal condition in species.

The finely divided leaves which some amphibious plants put forth when growing in water are as truly characters of the species as the entire leaves shown by plants growing on dry soil. Even the same individual when transplanted from one habitat to the other changes the character of its leaves. The environment merely calls one alternative or another into expression, just as the pupils of our eyes open in the darkness and contract in the light. It is not necessary to suppose that characters which are changed with changes of environment are products of environment or that such changes add anything to the evolutionary progress of the species.

How the external influence works upon the internal adjustments so as to call forth a substitution of one alternative character for another is still unknown, but there is no lack of evidence that such relations exist. To take the adjustments of such characters as examples of evolution is another way of confusing the result with the cause.

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[a] Cook, O. F. Mendelism and Other Methods of Descent. Proc. Washington Academy of Sciences, 9: 189. 1907.

A Mendelian method of inheritance, by the alternative transmission of contrasted characters in pure germ cells, could have no direct relation to evolution. It has been shown by Mr. G. H. Hardy (Science, n. s., 28: 49) that a character inherited in the Mendelian fashion would not tend to spread through a species. The proportion in which such a character was represented in a group would not increase with successive generations, but would preserve a constant average after the second generation, if there were no selection or other interference.

The power of external conditions to influence expression is not limited to the substitution of one environmental character for another. The phenomena of acclimatization, no less than those of mutation, require to be brought into relation with the facts of normal diversity. Transfers of cotton and other plants to new conditions are often followed by striking changes of characters far beyond the range of ordinary environmental accommodations. Sometimes all the individuals of the same planting change in the same way,[a] and sometimes a wonderful individual diversity is aroused.

Instead of rare mutations of a few individuals of an otherwise uniform variety, there is a promiscuous mutation of all the individuals at once, each in a different direction. To believe that the same environment makes all these diverse characters anew is obviously unreasonable. But when the normal diversity of the members of species is recognized, and the fact that such diversities are transmitted, it becomes possible to understand that an unwonted condition may recall many ancestral diversities into expression by disturbing the internal relations which govern the expressions of the characters. The result is the same as though the plants were making experiments with all the various degrees and combinations of their ancestral characters to see which might be best adapted to the strange surroundings. Thus, the planting of a variety under new conditions may serve the same purpose as hybridization in recalling diverse characters to expression.

CHARACTERS NOT DIRECTLY MOLDED BY ENVIRONMENT.

In the century before Darwin many students of nature interpreted facts of adaptation as indications of evolution. But instead of appreciating evolution as progressive change in species, most of the pre-Darwinian evolutionists dwelt upon the idea that the organisms were directly molded by their environments into adaptive conformity. They assumed that all of the diversities found among members of the same species are due to inequalities of environment, and pointed to the results of environmental limitations and adjustments as true examples of evolution. This idea of evolution as a direct result of environmental influences has continued to find supporters. Many attempts have been made to substitute the teaching of Lamarck for that of Darwin, or to supplement natural selection by alleged environmental factors.

Darwin's superior insight enabled him to take an important step in advance of his predecessors. He agreed with them that adapta-

[a] Dr. C. A. White, of Washington, D. C., has described such changes in the tomato and calls them aggregate mutations. The Mutations of Lycopersicum, Popular Science Monthly, 47: 151.

tion shows relation to the environment, but judged that the relation is not direct. He recognized also that evolution pertains to species, not merely to organisms in mass, and he found in natural selection the way by which evolutionary changes in species are influenced indirectly by their environments. Those who have rejected selection and returned to Lamarck's theory of adaptive evolution through a direct molding of characters by the environment have not made good their case. To find that selection does not produce new characters does not prove that they are produced by the environment. It has not been shown that the environment has any active constructive influence in descent, either in individual organisms or in species at large.

The environment often appears to change the characters of organisms, but there is no indication that these changes represent progressive evolution. All forms of environmental influence thus far discovered can be interpreted in one or two ways, either as limitations of existing characters or as substitutions. Mutilations, diseases, and similar abnormalities imposed by the environment often destroy organisms or weaken their progeny, but are not known to contribute anything to evolutionary progress. The substitution of one character for another as following an environmental change or interference can not be accepted as the formation of a new character, now that organisms are known to inherit and transmit characters in latent form and to bring one or another into expression with or without relation to external conditions.

DIRECTIONS OF EVOLUTION NOT FIXED.

Other writers have turned away from the external environment to seek the causes of evolution in internal substances or mechanisms of heredity. From minutely detailed studies of species of Hieracium, Naegeli gained a conception of evolutionary motion as tending to carry species in definite directions, and incorporated this idea into a theory of the structure of protoplasm. He refused to accept Darwin's opinion that species are variable indefinitely in all directions, but declared that they vary in single definite directions.

The facts are again matters of observation. The members of a normal sexual species have many kinds of diversity, showing that many evolutionary changes can go on simultaneously in the same species. It has been found that Hieracium is parthenogenetic; that is, the flowers frequently develop seed without fertilization. This explains the unusual constancy of characters, for parthenogenesis is like vegetative propagation in being exempt from the indiscriminate diversity shown in normally sexual groups. The variations of parthenogenetic plants are not shared among the different lines of

descent, but follow separate courses and gradually diverge in definite directions. Nevertheless, these more definite changes are not to be accepted as examples of normal evolution, for they lead toward sterility and extinction if sexual reproduction does not intervene.

Naegeli's conception of internal causes of evolution through protoplasmic mechanisms of heredity has been borrowed and combined with many other theories, sometimes even with the idea of evolution by environmental causation. Weismann denied the inheritance of characters imposed on the bodies of organisms by the environment, but conjectured that heritable characters might be imposed by the environment directly upon the germ cells. This made it possible to think of evolution as carried forward by environmentally directed variations, so that adaptation would be explained without natural selection. A return toward Lamarck's doctrine became possible for those who wished to reject natural selection because it did not explain variation.

That natural selection is not responsible for all that has been ascribed to it does not justify a neglect to appreciate its true power of leading the evolutions of species toward adaptation. If the directions of evolution were fixed in advance or controlled by internal mechanisms, the preservation of the species would depend altogether upon coincidence. Selection would have no power to influence the direction of evolution.

Adaptations are too numerous and too finely specialized to be explained as mere coincidences; they are joint products of evolution and selection. Though not adequate to prove that the evolutionary motions of species are caused by the selective agency of the environment, the testimony of adaptation is ample to show that the evolutionary directions of species are not definitely determined by internal agencies or mechanisms.

DIVERSITY A FACTOR IN NATURAL EVOLUTION.

The problem of evolution always leads back to the discussion of variation, because this term is used to cover all the differences found among the members of a species. Somewhere among the internal diversities of the species are characters which at some future time will become the common property of the whole group and serve to distinguish it from other species in which these characters do not develop. The problem is to fix upon the truly evolutionary differences.

Several kinds of differences have been used as examples of evolution, as shown in the previous pages. Some writers have looked upon the fluctuating individual differences of narrow-bred varieties as the means of evolutionary progress, while others have considered that

new species are formed by sudden mutations. A third doctrine treats of environmental variations as representing evolution; a fourth would illustrate evolution by the smaller and more definite changes found in parthenogenetic and self-fertilized varieties.

There is still another type of diversity which seems to have more significance in evolution than any of the preceding. This is the normal diversity of natural broad-bred species, the differences found in species before descent is restricted—differences manifest even when the conditions are so uniform as to call forth no environmental variation.

To distinguish this diversity of normal descent from fluctuating and environmental variations, the word "heterism" has been used. Heterism can be eliminated by restricting descent to narrow groups or to individual lines, and can thus be distinguished from the fluctuating differences that are always to be detected, even in the most uniform of our narrow-bred domesticated varieties.

Fluctuating differences have been subjected to careful statistical study and have been found to conform to mathematical curves of chance distribution, like curves made from the records of a marksman shooting at a target. This conception of chance deviation from a fixed standard of heredity evidently does not apply to sexuality and other normal forms of diversity among the members of species. Fluctuations continue to be shown alike on all the lines of descent into which a species may be separated, but heteristic differences are separately expressed on different lines of descent when a species is subdivided by selective narrow breeding. The fact that all characters fluctuate leaves the fluctuating variations without special significance in evolution, though they are of interest in showing that uniformity is an artificial ideal not to be attained in practice, even under experimental conditions.

Sexual differences represent a very highly specialized form of heterism, but all gradations of diversity are found between sexual differences and mere environmental variations and fluctuations. Though evolution is a gradual process it is not necessary to suppose that advance takes place only by the selective accumulation of infinitesimal fluctuating differences. Normal diversity of descent provides for free substitutions and alternations in the expression of a much wider range of characters.

In diversities of descent rather than environmental or fluctuating variations are to be found causes of evolution, factors of change in the characters of species. Heterism does not serve the purposes of evolution alone. It has a physiological value in reproduction. High-grade organisms are the offspring of diverse parents. The higher

we go in the scale of life the more numerous and complex are the provisions for securing this diversity of parentage. Heterism thus contributes to evolution in two ways, by maintaining the vitality of the species and by furnishing the characters by which the species can change.

BROAD BREEDING A FACTOR IN NATURAL EVOLUTION.

Another cause of evolution is free interbreeding among the members of a species to maintain a broad network of descent. A species is an evolutionary unit because its members travel together along the path of development. Unless new characters were distributed through the species by broad interbreeding there would be no such evolution as that shown in nature. Characters would remain the exclusive property of single lines of descent, as in varieties of plants propagated from cuttings.

Complex structures are not developed without binding the species into a broad, continuous network. Among all the higher types of plants and animals the processes of descent are normally sexual and thus insure the weaving of a network of descent. Constructive evolution ceases whenever the network is cut into narrow strands or individual lines of descent; changes continue to take place, but leading toward degeneration.

The theory that natural selection is the cause of evolution led Darwin and many later writers to regard free interbreeding among the members of a species as an obstacle or hindrance to evolution. Broad breeding would hinder evolution if progress were dependent upon the selective restriction of descent, as in domesticated varieties. Broad breeding does not conflict with evolutionary changes in the network of descent of a natural species; such changes are facilitated by the distribution and combination of the characters of the component organisms.

The evolutionary prosperity of a normal species means large numbers, wide distribution, and abundant individual diversity. It contrasts at every point with the results of narrow selection, and warns us that the systems by which we breed our domestic animals and plants are contrary to the conditions of normal evolution.

Evolution is still to be defined as a process of change in the characters of species, but several kinds of changes in the characters of species have to be distinguished from the genuinely evolutionary changes. The paring away of species by selection, the dividing of species by isolation, the adjustments of characters to external conditions, and the suppression of characters by narrow breeding are processes as

different from evolution as they are from each other. They can all be studied from the evolutionary standpoint, but they do not represent evolution itself. They are not the progressive, constructive changes through which the world of organisms has come into existence. They show some of the consequences of evolution, but do not reveal its true nature or its motive power.

NARROW BREEDING A FACTOR IN DOMESTICATED VARIETIES.

Changes occur under conditions of narrow breeding which would not take place if descent remained unrestricted, but these changes do not represent a true evolution. Narrow breeding induces degenerative variations, but is at the same time our readiest means of making such variations serve our economic purposes. Any type is degenerate which is no longer on the pathway of constructive, progressive evolution.

The practical importance of our agricultural improvements of plants and animals is not lessened by the fact that they are not evolutionary improvements, but include many kinds and stages of degeneration. Nor is it any less a part of evolutionary science to study these valuable degenerations and ascertain the best methods of producing them. Breeders of specialized varieties have the problem of increasing desirable degenerations as much as possible, with as little as possible of injurious degeneration, such as weakness or sterility.

It is here that the belief in selection as the cause of evolution brings confusion and discord into the art of breeding. Darwin concluded, after weighing much evidence, that persistent narrow breeding always results in degeneration, because it violates a general law of nature. He makes the following statement:

> These two great classes of facts, namely, the good derived from crossing and the evil from close interbreeding, with the consideration of the innumerable adaptations throughout nature for compelling, or favouring, or at least permitting, the occasional union of distinct individuals, taken together, lead to the conclusion that it is a law of nature that organic beings shall not fertilize themselves for perpetuity.[a]

As long as selection is represented as the chief agency of evolution, the teaching of science will appear to favor the indiscriminate application of narrow breeding instead of warning against its dangers and limitations. The idea that selective restriction of descent is the cause of evolution is not in accord with a law of nature against close breeding. To hold that organic progress depends on selection and isolation is to place evolution in conflict with itself. It amounts to saying that

[a] Darwin, Charles. Variation of Animals and Plants Under Domestication, New York edition, 2:159. 1897.

evolution is everywhere working to prevent evolution, since every adaptation to facilitate interbreeding is at the same time an obstacle to the restriction of descent required by the theory that selection causes evolution.

When diversity of descent and broad breeding are recognized as the conditions of normal reproduction and evolutionary progress, this contradiction disappears and the meaning of the law against perpetual narrow breeding becomes plain. It no longer appears as a merely arbitrary regulation applied to some species and not to others, but reveals essential requirements of organic existence and evolutionary progress. Broad networks of descent are necessary to maintain efficiency of reproduction and organic vigor in the species. To destroy the network of descent removes the support of the organic structure.[a]

Degeneration comes to narrow-bred organisms as surely as clocks run down when they are no longer wound. Some clocks run only a day; others may not need rewinding for a week, a month, or even a year. Species differ widely in their ability to live by vegetative propagation, parthenogenesis, self-fertilization, or other forms of descent in narrow lines. Nonsexual methods of reproduction are often very useful to supplement normal sexuality, but exclusive dependence on restricted descent evidently brings extinction to wild species as well as to domesticated varieties. Nonsexual methods are not found in consistent use in whole species, genera, and families of plants, but in a few narrowly restricted forms closely related to normally sexual types.

Deterioration is slower with vegetative propagation and other similar processes of descent in individual lines than with less discriminate forms of narrow breeding, but all forms of restricted descent lead ultimately to infertility and degeneration. Line breeding is superior to narrow breeding, but not superior to broad breeding. The elaborate contrivances of plants to secure cross-pollination show at once how difficult and precarious are the processes of sexual reproduction, and at the same time how indispensable.

MUTUAL RELATIONS OF PRINCIPAL FACTORS.

Diversity and broad breeding are not merely causes of evolution, but are necessary to normal processes of descent among all higher types of organisms. Evolution not only results from diversity and interbreeding, but at the same time brings increased diversity and improved adaptations for still broader breeding.

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[a] Cook, O. F., and Swingle, W. T. · Evolution of Cellular Structures. Bulletin 81, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1905.

The facts are concrete and their relations obvious. The members of each species are diverse (heterism). They freely interbreed among themselves (symbasis). They produce successive generations (descent). Later generations differ from the earlier (evolution). Without diversity, interbreeding has no significance, and descent is not accompanied by evolution. Heterism, symbasis, descent, and evolution form a continuous series, a complete chain of phenomena. For some purposes the four processes may be described as distinct, but physiologically they are mere phases or aspects of organic existence, each at once requiring and assisting the others.

Thus, the constitutions of species and the methods by which they are propagated show that they are in motion. We no longer seek to prove that species evolve; we see that they do and understand why they must continue to do so as long as they remain groups of normally diverse, broadly interbreeding organisms.

Diversity and interbreeding do not appear as causes of evolution in the same way that natural selection was supposed to be the cause. They are rather the general conditions or means of evolution. An actuating cause of evolution, in the narrow sense of an agency which takes hold of normally stationary species and changes their characters, it is not necessary to seek, since species do not tend to remain stationary in nature, nor do domesticated varieties continue constant even when breeders strive for uniformity.

The search for causes never ends. There is always something unknown behind the facts we are able to understand. The most that we can hope to do is to maintain the right direction in our inquiries. To have known that the causes are in the species and not in the environment would have saved many wanderings.

The only relations thus far established between evolution and environment are negative; the environment often hinders or limits evolution, but has not been found to cause any constructive change. On the other hand, normal diversity and free interbreeding have direct relations with evolution, for they represent essential conditions of the existence of species. Without them our species would not have the characters they now possess.

The true nature of evolution as a progressive change in the network of descent of a species, accomplished through diversity and interbreeding, was understood by Goethe a century ago. The statement of his evolutionary conclusions in metrical form may have caused them to be overlooked as scientific discoveries, but it is evident that he perceived the essential relations more clearly than the later writers who have ascribed evolution to environmental agencies or to restriction of descent. Goethe was an active investigator of natural phe-

nomena and represents himself as having studied and solved the problem of evolution, as shown in such passages as these:

Years ago it was a pleasure
Of the eager spirit's days,
Searching for the course and measure
Of creative Nature's ways.
Lo, a unity eternal
Stands in manifold revealed;
Large or small kinds, great or little,
Point one law in every field.
Always changing, yet enduring,
Far and near, by land or main,
Forming now, and now transforming—
Wondrous goal that I attain!

Radiant this truth has shown,
Vital more than any:
Nothing living lives alone,
Always there are many.

Behold we now the primal art,
The ancient Weaver-woman's part;
One tread uplifts a thousand lines
While back and forth the shuttles go,
And meeting strands together flow,
Each stroke a thousand unions twines;
Her web by no mere chance is made,
Forever has her warp been laid,
The Master-workman's one behoof
Content for aye to throw the woof.

EVOLUTION PROBLEM DISTINCT FROM DESCENT PROBLEM.

Many investigators have thought to reach the problem of evolution through the problem of descent. By learning how characters pass from one generation to another it was hoped to learn also how characters are changed during series of generations. The problem of descent was supposed to include the problem of evolution.

It now appears that evolution may throw light upon descent rather than descent upon evolution. Descent is carried on through individual organisms and conjugations of germ cells, but evolution is conducted through species. Until we recognize diversity and interbreeding as of physiological value, the elaborate complexities of descent by sexual reproduction appear wasteful and meaningless.

A species is a mutual physiological organization for the improvement of descent, instead of being a merely arbitrary assemblage of organisms fenced in by hostile environments and compelled to compete with each other in a struggle for existence. Adaptations for strengthening the network of descent by diversity and interbreeding exceed environmental adaptations in number and complexity. Adaptations for interbreeding are a permanent gain for the

species, while environmental adaptations may have only temporary advantage. The more perfect the adaptation to special conditions the smaller are the chances that the species can survive a change of environment.

Geology repeats in many different groups the lesson of the earlier extinction of the more specialized types and the preservation and continued progress of the less specialized, those able to maintain themselves under a wide range of conditions. The new types which appear to have arisen suddenly in remote geologic ages were already widely distributed. Instead of being confined to limited areas where interbreeding would be restricted, the species must have contained vast numbers of individuals, more than in the later times when these same groups become subdivided in their turn into many genera and species.

The higher we go in the scale of existence the greater is the need that we study cells and organisms in their social or collective relations. In the lower groups reproduction can be accomplished by simple splitting of single cells, but in the highest groups it requires the cooperation of two extremely complex organisms, each composed of millions of cells. In man and in many other social species, numerous individuals contribute to the nurture of the young, to bring them to fully developed maturity, and thus complete the process of descent. To maintain evolutionary progress a still wider cooperation is required, a huge assemblage of interbreeding individuals which constitutes a species.

Galton considered the system of double parentage as necessary to sustained efficiency of reproduction among the higher plants and animals, but this conception falls short of the full indications of evolutionary facts. Not merely double parentage, but a highly multiple ancestry is required to maintain a succession of complex organisms. The species rather than the individual is the true unit of organic existence and of evolutionary progress. Evolution may prove to be as essential a factor in descent as descent is in evolution. There is a general evolutionary physiology of species and varieties, as well as a special physiology of descent shown in the reproduction of individual organisms.

Cells may be thought of as containing mechanisms of descent, but species are mechanisms of evolution. The problem of evolution is much more accessible to our observation than the problem of descent, and comes first on the normal route of inquiry from the known to the unknown. Though closely allied, the two problems lie on different planes and can be studied separately. In bringing them into relation we should be careful not to bring them into confusion. We do not need to seek in the cells for the functions performed by the species.

To defer the recognition of evolutionary facts because our knowledge of descent remains incomplete would be much like refusing to walk or to practice manual arts until we should have a complete explanation of the mechanism of contraction in the cells of muscles, on which our bodily movements depend. It may be long before we can gain any complete understanding of the physiology of descent, of the activities and relations of cells in organisms, but this need not prevent our gaining knowledge of the physiology of evolution, the relations of lines of descent in species.

EVOLUTION INHERENT IN SPECIES.

A normally constituted species can carry forward changes of characters without environmental or selective causation. Under natural conditions of free interbreeding, new variations and combinations of characters are to be thought of as tending to spread and to transform the species or to accentuate the normal and desirable diversity of descent inside the species. The evolutionary development of a species is as spontaneous as the growth of the individual plants and animals of which the species is composed. External conditions influence the evolution of species, just as they influence the development of individual organisms, but both forms of growth are manifestations of life, not effects of inanimate surroundings.

Environmental utility influences the rapidity of extension and uniformity of expression of characters, but useless characters can also spread and serve the species physiologically by ministering to a healthful diversity of descent. The state of free interbreeding found in natural species is most favorable for evolutionary progress; no rare or exceptional conditions have to be imagined.

Evolution is analogous to history. The importance of events is determined by the conditions and the sequences in which they occur. Species are not carried along by their environments, nor compelled by internal clockworks to change at particular times or to go in definite directions. Nevertheless, the timely putting forth of a new character may have a profound influence upon the subsequent history of a species. Variation is genetic, for species tend to evolve, but it is not definitely directed or determined (orthogenetic). A character once formed tends to further development, and thus finds the range of greatest utility or of most harmonious combination.

Though evolution is often described as a doctrine of transformation, the earlier theories really taught only the selective substitution of one species or variety for another; they did not provide for the transformation of species. They represent evolution as possible only when descent is restricted by selection or other means of isolation, and require at every step highly improbable coincidences between varia-

tion and isolation. An advantageous new character, if not prepotent, would be preserved and extended only when opportunely separated from the unmodified type, but a prepotent variation, whether useful or not, can gradually pervade and transform the species. There is no need that it be isolated from the parental stock or that it wage a selective warfare of extermination against its nearest relatives.

CONCLUSIONS.

Relation of evolution to species.—The evolution of the higher types of plants and animals is an essentially complex process, not to be accomplished without the association of organisms in species and not to be understood without recognizing that the association of organisms into species has a concrete physiological significance. Evolution is change in species. Unless we learn how species are constituted we do not become acquainted with the results of evolution or with the conditions under which it takes place.

The constitution of species.—Species in a normal condition of evolutionary progress are large groups of diverse, freely interbreeding organisms. The joining of the lines of descent of each specific assemblage into a huge, continuous network provides for endless individual diversity by free combinations and substitutions among gradually changing characters. New characters must combine harmoniously with old characters and must spread through the network of descent of the species.

The method of evolution.—A comparison of the diversities found among members of the same species with the diversities of separate species shows that evolutionary changes in the characters of species are completely gradual and continuous. Species are found in nature in all stages of division and divergence. Evolution does not depend on occasional originations of new species, nor upon abrupt changes of characters in individual organisms, but it is shown in gradual changes of the characters of the organisms of which species are composed. Species may be differentiated without any new characters being added, or new characters may arise in a species though no subdivision takes place.

Causes of evolution.—The differentiation of species and the attainment of new characters and functions are results of evolution made possible by the facts that the members of species are normally diverse, and that there is free interbreeding in the networks of descent. Evolution is not caused by the struggle for existence, nor limited to characters of environmental fitness. Harmless and even harmful characters may be acquired by species in the same way as beneficial adaptations.

Expression of characters distinct from transmission.—The number of characters that organisms inherit from their ancestors and transmit to their descendants is much greater than can be brought to visible expression in any individual. Reversions show that characters may be transmitted in latent form for many generations and then suddenly reappear. On the other hand, characters long expressed with regularity may suddenly disappear, as often occurs in mutations. Many of the differences which have been used as examples of evolution represent mere substitutions and alternations among characters already evolved by the species, instead of evolutionary progress toward new characters.

Influence of external conditions on expression of characters.—The conditions of existence often influence the expression of characters in individual organisms, calling some characters into expression and leaving others latent. In different environments the same species, or even the same individual organism, may put forth different characters.

By varying expressions of their characters, organisms are able to adjust themselves to wider ranges of environmental conditions, but this versatility does not indicate that the environment is responsible for the formation of new characters or for the evolutionary progress of species. Doctrines of environmental causation of evolution tend to deceive us with the false hope of making over inferior breeds by environmental manipulation, instead of leading us to appreciate the primary importance of normal descent.

Influence of selection on expression of characters.—Changes induced by the narrow artificial selection of domesticated plants and animals are not true examples or equivalents of natural evolution. The removal from a group of all the individuals which show a certain character tends to suppress this character. The selective suppression of characters renders the members of a group more uniform, but it does not make new characters. Selection works by eliminating differences; evolution comes by introducing them. Selection is an analytic process, while evolution is synthetic. Evolution can be guided through selection, but the guidance must not be too narrow or conditions essential to the continued existence of organisms are destroyed. The teaching that evolution is caused by the selective action of the environment and hindered by interbreeding among the members of the species reverses the facts of nature. The environment permits some changes and forbids others, and can thus limit the directions in which the changes proceed, but the changes are put forth by the species, instead of being actuated by the environment.

Status of domesticated varieties.—Uniform domesticated varieties are small groups in which the normal diversity has been suppressed by selection. The greater uniformity is secured at the expense of normal

diversity and free interbreeding, the primary conditions of constructive natural evolution.

The idea that uniformity is to be sought for its own sake or that "pure-bred" uniform types are essentially superior to those showing greater individual diversity finds no warrant in the general facts of evolution. It is misleading and dangerous to advise that all domesticated types of plants be made uniform by breeding from single individuals. To the extent that it is necessary to obtain uniform commerical products, restriction of descent to individual lines may be justified, but not on the ground that it represents a normal or truly evolutionary condition.

Evolution must continue to furnish the materials for breeding. It is vain to expect that the work of breeding in any economic group can be finished by securing narrow strains, however superior. Narrowly selected breeds must continue in the future, as in the past, to follow in a gradual succession, the older and weaker being discarded for the newer and more vigorous, more recently derived from broadly interbreeding stocks.

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 137.

B. T. GALLOWAY, *Chief of Bureau.*

SEEDS AND PLANTS IMPORTED

DURING THE PERIOD FROM JANUARY 1 TO MARCH 31, 1908:

INVENTORY No. 14; Nos. 21732 TO 22510.

ISSUED JANUARY 9, 1909.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., October 5, 1908.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 137 of the series of this Bureau, the accompanying manuscript, entitled "Seeds and Plants Imported During the Period from January 1 to March 31, 1908: Inventory No. 14; Nos. 21732 to 22510."

This manuscript has been submitted by the Agricultural Explorer in Charge of Foreign Seed and Plant Introduction with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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CONTENTS.

B. P. I.—415.

SEEDS AND PLANTS IMPORTED DURING THE PERIOD FROM JANUARY 1 TO MARCH 31, 1908: INVENTORY NO. 14; NOS. 21732 TO 22510.

INTRODUCTORY STATEMENT.

With this fourteenth inventory of seeds and plants imported from abroad is inaugurated a new departure. The volume of interesting matter pertaining to these new introductions has become so great and the desirability of getting out printed descriptions for the use of those handling them is so apparent that it has been decided to issue the inventory as soon as possible after each period of three months of introduction work.

This plan, it is believed, will interest the friends of these new immigrants and insure them better attention in the homes which are being created for them in America.

Since January 1, 778 introductions have come in, i. e., at the rate of more than 8 a day, and among these it is worth while to call attention to certain ones which are of unusual interest.

Mr. Frank N. Meyer has continued his explorations in northern China and this inventory contains 179 of his introductions. Among them are some remarkable wild chestnuts, wild walnuts, oaks, crab apples, and pears from the Chihli Province; seeds of the original chrysanthemum from which most of the cultivated forms are supposed to have originated; a collection of apples and pears from Pangshan; several elms of some promise; *Pyrus betulaefolia*, the species on which in China the native pears are grafted and which distinguishes itself as easily grown from cuttings; and the Fei-tao peach of Feitcheng, which is known all over North China as the finest peach in the Empire. It is a clingstone, and individual fruits in the dry region of the Shantung Province attain a weight of 1 pound. Possibly this is the Chinese Cling already known in America, although such extraordinary fruits are not produced in this country, and this may be an entirely new and most valuable addition to the peaches of the United States.

Perhaps the most remarkable of all of Mr. Meyer's finds are the Chinese dates, which, by the way, are not dates at all, but delicious fruits borne on deciduous trees (*Zizyphus sativa*) which will stand drought remarkably well. In the Shantung Province there appear to be as many kinds of these fruits as there are of plums in America. Large orchards of the plants are grown there, and the specimens of fruits which Mr. Meyer has sent in encourage us to think that they may vie with the real date as an orchard culture in the dry West where they can be grown. Good judges of fruit have not hesitated to pronounce the samples sent in as equal in delicacy to, though entirely different from, the finest dates. The Office of Plant Life History Investigations has the development of this new industry on its programme for the coming year.

An interesting dry-land naked oat, some new buckwheats, a new stock for the peach (*Amygdalus davidiana*), new and most interesting sorghums, more forms of the Chinese hardy persimmon, a horse-chestnut that is evidently new to the country and may be a superior shade tree, new drought-resistant cherries, and one or perhaps two new yellow roses, for which the rose breeders are already clamoring, are others of Mr. Meyer's finds.

Among the importations which have come in through our foreign correspondents, the following may be especially emphasized: A shipment of cork-oak acorns from Spain; a collection of Rheums from Russia for the rhubarb breeders; seeds of the Chilgoza pine, a remarkable nut-bearing pine from Baluchistan; the Grano Marzuolo, a variety of dwarf wheat used in Italy for the plaiting industry; the Amoy pomelo; the wild emmer, a remarkable new grain from Palestine; large collections of cowpeas and sorghums from the Orient; the Guayaquil pineapple from Ecuador; the nut oak (*Quercus cornea*) from Hongkong; an African asparagus for the asparagus breeders; the wild licorice of Greece; a collection of taros from Hawaii; a collection of 215 varieties of tobacco, the most generous gift of the noted tobacco expert, Prof. Dr. O. Comes, of the Agricultural School of Portici, Italy (doubtless the largest collection of tobaccos ever gotten together); wild olives and pistaches from Baluchistan; and a collection of Japanese radishes.

Botanists will note that an attempt is made in this inventory to name each introduction and give the botanical authority for the name. Anyone familiar with such work will realize that it is not possible to do this with absolute accuracy, as often only seeds or cuttings are at the disposal of the determining botanist. Mr. W. F. Wight and, under his direction, Mr. H. C. Skeels have been given charge of this feature of the inventory, and with Miss Mary A. Austin responsible for the preparation of the inventory cards it is believed that in the

future these inventories of newly imported plants will not only be more accurate, but will contain more useful information and will appear more promptly than in the past, and in this way become of much more value to the experimenters who are studying the new things as they come in.

David Fairchild,
Agricultural Explorer in Charge.

Office of Foreign Seed and Plant Introduction,
Washington, D. C., September 14, 1908.

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INVENTORY.

21732. QUERCUS SUBER L. **Cork oak.**

From Gibraltar, Spain. Procured by Hon. R. L. Sprague, American consul. Received December 30, 1907.

"Seed imported for experiments in the introduction of the cork oak in the Southern States and California." (*Fisher.*)

21733. TRIFOLIUM SUBROTUNDUM Steud. & Hochst.

From Kisumu, British East Africa. Presented by Mr. Arthur B. Chilson. Received December 26, 1907.

"African clover. This grew 5,300 feet above sea level, 8 miles north of the equator, about 20 miles northeast of Lake Victoria. I have never found it growing lower than 4,000 feet above sea level. This is a very hardy variety of clover able to stand extremes of dry and wet weather. It sometimes grows to a height of 2 feet, but is usually much shorter. The blossom is red with often a slight mixture of white; smaller than the red-topped variety in America, but larger than the white clover." (*Chilson.*)

"In Abyssinia cultivated as forage under the name of 'Mayad.'" (*Oliver, D., Flora of Tropical Africa, 1871, vol. 2, p. 59.*)

21734. ROSA HUGONIS Hemsl.

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received January 3, 1908.

21735. MEDICAGO SATIVA L. **Alfalfa.**

From Alma, Nebr. Purchased from Mr. Conrad Boehler. Received January 6, 1908.

Grimm. Grown from S. P. I. No. 12991. Grown especially for the Department, under direction of Forage Crop Investigations, by Mr. Conrad Boehler.

21736. PANICUM OBTUSUM H. B. K.

From Roswell, N. Mex. Collected on special order by the Roswell Seed Company. Received January 6, 1908.

"A native grass especially abundant in low or moist soil. It should be tested under irrigation, as it promises to give several cuttings each season." (*C. V. Piper.*)

21737 to 21749.

From Kew, England. Presented by Dr. David Prain, director, Royal Botanic Garden. Received December 31, 1907.

Cuttings of the following:

21737 to 21740. ROSA spp. **Rose.**

21737. *Helene.*

21738. *Electra.*

21739. *Una.*

21740. *Austrian Copper Briar.*

21737 to 21749—Continued.

21741. Rosa spinosissima L.

21742. Rosa sp.

21743. Rosa sericea Lindl.

21744. Rubus lasiostylus Focke.

21745. Rubus microphyllus L. f.

21746. Ribes cruentum Greene.

Seeds of the following:

21747. Rosa soulieana Crépin.

21748. Rubus crataegifolius Bunge.

21749. Ribes wolfii Rothr.

21750. Albizzia adianthifolia (Schum.) (Mimosa adianthifolia Schum.)

From Thornwood Estate, M'lanje, British Central Africa. Received from Mr. Henry Brown, through Mr. C. J. Petherick, No. 4 Trafalgar Square, London, England, January 6, 1908.

"A very fast growing, leguminous tree; table-topped, feathery leaved, and very suitable for shade for coffee, cocoa, tea, and other productions which may grow in America. The tree yields an excellent timber very like satin wood in the grain." (*Brown.*)

21751. Avena sterilis L. **Oat.**

From the Province of Ispahan, Persia. Presented by Mr. John Tyler, American consular agent, Teheran, Persia. Received September, 1907.

Porringe. "Seed of a wild oat they call *Porringe.* I should think the original of our 'porridge.' It is used the same as oatmeal." (*Tyler.*)

21752. Cucumis sativus L. **Cucumber.**

From Korea. Presented by the Yokohama Nursery Company, Yokohama, Japan. Received January 2, 1908.

"Said to be different from our variety." (*Yokohama Nursery Company.*)

21753. Phoenix ouseleyana Griff. (Phoenix humilis Royle.) **Date.**

From Sibpur, Calcutta, India. Presented by Capt. A. T. Gage, superintendent, Royal Botanic Garden. Received October 3, 1907.

"The *Phoenix humilis* above is the *P. humilis* of Royle (see Royle, Illust. Bot. Him.), and not *P. humilis* Cav. Ic., which is equivalent to *Chamaerops humilis* of the Mediterranean region." (*W. W. Smith.*)

21754 to 21757. Glycine hispida (Moench) Maxim. **Soy bean.**

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received January 3, 1908.

21754. Yellow seeded.

21755. *Ogemaw.* Extra early, brown seeded.

21756. Black seeded.

21757. Extra early, black seeded.

21758 to 21767. RHEUM spp. **Rhubarb.**

From St. Petersburg, Russia. Presented by Dr. A. Fischer von Waldheim, director, Imperial Botanic Garden. Received January 6, 1908.

21758. RHEUM RHAPONTICUM L.

Queen Victoria.

21759. RHEUM UNDULATUM L.

21760. RHEUM RHAPONTICUM L.

21761. RHEUM PALMATUM TANGUTICUM Maxim.

21762. RHEUM PALMATUM L.

Red flowered.

21763. RHEUM AUSTRALE Don.

21764. RHEUM COMPACTUM L.

21765. RHEUM PALMATUM ATROPURPUREUM.

21766. RHEUM MOORCROFTIANUM Royle.

21767. RHEUM ACUMINATUM Hook. f. & Thomas.

21768 and 21769. MEDICAGO SATIVA L. **Alfalfa.**

From Bassorah, Persian Gulf. Purchased from Mr. H. P. Chalk, agent for the Hills Brothers Company, New York. Received January 7, 1908.

Arabian alfalfa or *Jet.*

21768. Seed from unirrigated plants.

21769. Seed from irrigated plants.

21770 to 21778.

From French Guinea. Presented by M. Aug. Chevalier, 63 Rue de Buffon, Paris, France. Received January 10, 1908.

21770. IPOMOEA BATATAS (L.) Poir. **Sweet potato.**

21771. IPOMOEA BATATAS (L.) Poir. **Sweet potato.**

21772. IPOMOEA BATATAS (L.) Poir. **Sweet potato.**

21773. COLEUS sp.

21774. COLEUS sp.

21775. DIOSCOREA BULBIFERA L.

21776. MUSA sp. **Banana.**

21777. XANTHOSOMA SAGITTAEFOLIUM (L.) Schott. **Yautia.**

White.

21778. XANTHOSOMA SAGITTAEFOLIUM (L.) Schott. **Yautia.**

Rose.

21779. CITRUS NOBILIS × VULGARIS.

From Algiers, Algeria. Presented by Dr. L. Trabut, government botanist. Received January 9, 1908.

"Fruit large, mediocre, colored." (*Trabut.*)

21780 to 21782.

From Ichang, Hupeh, China. Secured by Mr. E. H. Wilson, of the Arnold Arboretum, Jamaica Plain, Mass., in cooperation with this Department. Received January, 1908.

21780 to 21782—Continued.

A collection of seeds, as follows:

21780. Cannabis sativa L. **Hemp.**

"(No. 428, Dec. 8, 1907.) Seeds of a particularly robust form of this well-known hemp. This form of *Cannabis* is commonly cultivated in association with maize by peasants and farmers on the mountains north and south of Ichang at altitudes between 3,000 and 5,000 feet. The plants vary from 6 to 12 feet, and the lower part of the stem is often 4 inches in circumference.

"This plant is cultivated exclusively for the oil which is expressed from the seeds after grinding and steaming in the ordinary Chinese way. This oil is used for illuminating purposes and is valued on account of its noncongealing in the coldest of weather. The stems are used for fuel, though a little fiber is occasionally used for making sundries for local use.

"It is the *Tung ma* (cold hemp) of these parts." (*Wilson.*)

21781. Actinidia chinensis Planch. **Yangtaw.**

"(No. 347, Dec. 8, 1907.) A robust climber, 10 to 30 feet high; leaves and young shoots covered with bright crimson villous hairs. Flowers unisexual or hermaphrodite, buff-yellow to white, fragrant, 1 to 1½ inches across, produced in great profusion. Fruits abundantly produced, ovoid to globose, 1 to 2½ inches long, 1 to 1½ inches across, epicarp membranous, russet-brown, more or less clothed with villous hairs. Flesh green, of most excellent flavor, to my palate akin to that of the common gooseberry but tempered with a flavor peculiarly its own.

"The plant is common in thickets and margins of woods from 3,000 to 4,000 feet high in western Hupeh and Szechuan. Also known from the Hushan Mountains in Kiangsi Province and from Fokien.

"The plant is highly ornamental, either in foliage or in flower. The fruits are excellent for either dessert or making into preserves.

"Introduced by me to the nurseries of Veitch & Sons, of Chelsea, London, and quite hardy in England.

"Local native name, *Yang tao* (strawberry peach)." (*Wilson.*)

21782. Eucommia ulmoides Oliver. **Tu-chung.**

"(No. 383, Dec. 8, 1907.) Tree 25 to 40 feet by 1½ to 4 feet. Cultivated in western Hupeh and Szechuan at altitudes between 1,000 and 4,500 feet. The tree is valued for its bark, which constitutes the native drug *Tu-chung*. The bark, leaves, and fruit contain silky, elastic fibers composed largely of a caoutchouc-like substance akin to balata. As a rubber-producing plant, however, the plant has little value.

"Eucommia was introduced from China into France by Vilmorin and into England by myself. In both countries it has proved quite hardy. In Algiers and parts of Tonking this tree has been experimentally planted by the French as a rubber-producing tree.

"The medicine *Tu-chung* is valued as a tonic and mild aphrodisiac.

"The customs' valuation here is: First quality, 30 taels per picul; second quality, 20 taels per picul; third quality, 10 taels per picul." (*Wilson.*)

21783. Bauhinia picta (H. B. K.) DC.

From Miami, Fla. Grown in 1907 at the Subtropical Laboratory and Garden from seed presented by Mr. J. C. Harvey, Sanborn, Vera Cruz, Mexico; distributed from Subtropical Laboratory and Garden.

"An unarmed shrub with nearly orbicular leaves, about 3½ inches long, and solitary terminal racemes, 2 to 3 inches long, of white flowers spotted with red." (*W. F. Wight.*)

21784 to 21805.

From Sibpur, Calcutta, India. Presented by Capt. A. T. Gage, superintendent, Royal Botanic Gardens. Received January 10, 1908.

21784 to 21805—Continued.

A collection of seeds, as follows:

21784. CICER ARIETINUM L. **Chick-pea.**

White seeded.

21785. CICER ARIETINUM L. **Chick-pea.**

Clay seeded.

21786. CICER ARIETINUM L. **Chick-pea.**

21787. PHASEOLUS RADIATUS L. **Mung bean.**

21788. PHASEOLUS RADIATUS L. **Mung bean.**

21789. PHASEOLUS RADIATUS L. **Mung bean.**

21790. PHASEOLUS PILOSUS H. B. K.

21791. VIGNA SESQUIPEDALIS (L.) W. F. Wight.

Lobia.

21792. VIGNA CATJANG (Burm.) Walp. **Catjang.**

Red podded.

21793. VIGNA UNGUICULATA (L.) Walp. **Cowpea.**

White.

21794. PISUM SATIVUM L. **Pea.**

White.

21795. PISUM SATIVUM L. **Pea.**

21796. LATHYRUS sp.

21797. SESBAN BISPINOSA (Jacq.) Steud. (AESCHYNOMENE BISPINOSA Jacq.)

21798. LAGENARIA VULGARIS Ser. **Gourd.**

21799. ABELMOSCHUS ESCULENTUS (L.) Moench.

21800. CARICA PAPAYA L. **Papaw.**

21801. BENINCASA CERIFERA Savi. **Wax gourd.**

21802. CUCUMIS SATIVUS L. **Cucumber.**

21803. CUCUMIS MELO L. **Muskmelon.**

21804. CUCURBITA PEPO L. **Pumpkin.**

21805. CITRULLUS VULGARIS Schrad. **Apple-seeded watermelon.**

21806. RAPHANUS SATIVUS L. **Radish.**

From Macassar, Celebes, Dutch East Indies. Presented by Mr. Wiebe P. de Jong, American consular agent. Received January 6, 1908.

21807. ANDROPOGON SORGHUM (L.) Brot. **Sorghum.**

From Descanso, Cal. Presented by Mr. E. P. St. John. Received January 9, 1908.

"*Roosevelt's Forty-Four.* A 'sport' selected from a field of *Amber* sorghum in 1905. Is a heavy stooler; lacks in sweetness, but has good fodder." (*St. John.*)

21808 and 21809.

From Pretoria, Transvaal. Presented by Mr. C. L. Legat, Conservator of Forests, Transvaal Department of Agriculture. Received January 14, 1908.

21808 and 21809—Continued.

21808. BOLUSANTHUS SPECIOSUS (Bolus) Harms.

"This is an exceptionally beautiful tree, probably the handsomest native species we have. It should thrive well in any region where oranges grow." (*Legat.*)

21809. TRICHILIA EMETICA Vahl.

From Lower Umzimkulu, Natal. Collected by Miss Reid, September, 1907.

"A fine shade tree for comparatively frostless regions." (*Legat.*)

21810. CITRUS NOBILIS Lour. **Tangerine.**

From Canton, Kwangtung, China. Presented by Dr. J. R. Huffaker, Brookfield, Mo. Received January 16, 1908.

"Seeds of the 'Golden orange,' so called by the Americans, and 'Honey orange' by the Chinese. The peel is quite loose, and sections easily separated, tender, very rich, juicy, and sweet." (*Huffaker.*)

21812. CYDONIA JAPONICA (Thunb.) Pers. **Japanese quince.**

From Shanghai, Kiangsu, China. Presented by Rev. J. M. W. Farnham, D. D. Received January 15, 1908.

"Seeds of a very large native quince." (*Farnham.*)

21813 to 21817. VIGNA UNGUICULATA (L.) Walp. **Cowpea.**

From Macassar, Celebes, Dutch East Indies. Presented by Mr. Wiebe P. de Jong, American consular agent. Received January 6, 1908.

21813. *Cream.*

21814. *Whippoorwill.*

21815. *Black-Eye.*

21816. *Clay.*

21817. *Black.*

21818. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received January 17, 1908.

Ito San. Called by the French, *Yellow Etampes.*

21819. PINUS GERARDIANA Wall. **Chilgoza pine.**

From Fort Sandeman, Baluchistan. Received from Lieut. Col. G. C. French, I. A., political agent in Zhob, through Prof. E. P. Stebbing, imperial forest zoologist to the Government of India, Calcutta, India, January 14, 1908.

"The Chilgoza pine, which bears an edible seed, is a moderate-sized tree confined in its native habitat to the inner dry and arid valleys of the northwestern Himalayas, from Kunawar westward, and in Gharwal. It is found in isolated areas of not great extent, and generally at altitudes between 6,000 and 12,000 feet. The trees are seen at their best at an elevation of about 8,000 feet, where they reach a height of 70 to 85 feet, with a girth of 9 to 12 feet. The species is quite hardy, as in a part of its range it often grows on what appears to be solid limestone rock, enduring high winds and severe winters with heavy snowfalls. The precipitation in the Chilgoza region is mostly in the form of snow and is only about 8 inches per annum.

"The chief product of this tree is the edible seed, nearly an inch in length, contained in the cones. The seeds are very nutritious and agreeable in flavor; they form a staple food of the inhabitants of Kunawar. A full-sized cone yields over 100 seeds, and each tree produces 15 to 25 cones." (*From letter of Consul-General Michael, March 21, 1907, and Forest Bulletin No. 7, 1906, by Mr. E. P. Stebbing, of India Forest Department.*)

"This tree is also common in northern Afghanistan." (*W. F. Wight.*)

21820. Xiphagrostis condensatus (Hack.) W. F. Wight. (Miscanthus condensatus Hack.)

From Yokohama, Japan. Purchased from the Yokohama Nursery Company. Received January 18, 1908.

(For description see No. 10524.)

21823. Lansium domesticum Jack. **Doekoe.**

From Manila, P. I. Presented by Mr. W. S. Lyon. Received January 6, 1908.

Philippine local name *Lanzon;* Java name *Doekoe.* "I have met it more or less widely throughout the archipelago, but, so far as I know, it only fruits abundantly and well in Laguna Province, Luzon, and in widely remote Joló.

"Fruits should become thoroughly mature before picking; those commonly found in the markets are picked when immature. I have sent ripe fruits from Manila to Yokohama (eleven days) and green ones to Honolulu (twenty-one days) successfully." (*Lyon.*)

21824 and 21825.

From Hokkaido, Japan. Presented by Mr. K. Hashimoto, Kuchchau Agricultural Society, Abutagun. Received January 14, 1908.

21824. Phaseolus angularis (Willd.) W. F. Wight. (Dolichos angularis Willd.) **Adzuki bean.**

Red. "Used in making ari." (*Hashimoto.*)

21825. Glycine hispida (Moench) Maxim. **Soy bean.**

Amherst (?). "Used in the manufacture of 'soy,' 'miso,' 'tifu,' etc." (*Hashimoto.*)

21826. Xanthosoma sagittaefolium (L.) Schott. **Yautia.**

From Georgetown, British Guiana. Presented by Mr. Donald Mitchell, American vice and deputy consul, through Mr. O. W. Barrett. Received September 4, 1906.

"The tubers of this variety were mingled with those of No. 19149, but when grown proved to be distinct from any other variety of yautia (?) in the collection." (*Barrett.*)

21827. Medicago sativa L. **Alfalfa.**

From Chinook, Mont. Purchased from Mr. F. G. Cooper. Received January 22, 1908.

Grimm.

21828 and 21829. Medicago sativa L. **Alfalfa.**

From the Sevier Valley, near Oasis, Utah. Purchased from Mr. A. F. Bliss, Deseret, Utah. Received January 22, 1908.

21828. First crop. **21829.** Second crop.

21830 and 21831. Glycine hispida (Moench) Maxim. **Soy bean.**

From Hokkaido, Japan. Presented by the Yokohama Nursery Company, Yokohama, Japan. Received January 24, 1908.

21830. *Butterball.* Japanese name *Akita.*

21831. Japanese name *Rumoi.*

21834 to 21836. ANDROPOGON SORGHUM (L.) Brot. **Kafir.**

From Maiduguri, Bornu, Sudan, Africa. Presented by Prof. J. Burtt Davy, agrostologist and botanist, Transvaal Department of Agriculture, Pretoria, Transvaal. Received January 27, 1908.

21834. *Black-Hull.*

21835. *Red Matakwa.*

21836. *White Matakwa.*

21837. BAMBOS ARUNDINACEA Retz. **Bamboo.**

From Sibpur, Calcutta, India. Presented by Capt. A. T. Gage, superintendent, Royal Botanic Garden, through Mr. W. W. Smith. Received January 28, 1908.

(For description see No. 21317.)

21838. TRITICUM AESTIVUM L. **Wheat.**

From Vomero, Naples, Italy. Presented by Dr. C. Sprenger. Received January 28, 1908.

"The kind of grain which is used for the straw-plaiting industry of Italy is *Triticum aestivum* var. *crimcron*, called commonly in Italian *Grano Marzuolo.*

"There are two undervarieties known, the *Santa Fiora* and the *Semone*, which are cultivated on poor, thin land. The seed is planted in the month of November and also in February, and sown very thickly. We pull it up when the ear begins to be formed." (*Angiolo Pucci.*)

"The straw used in the plaiting industry is that of a special kind of very dwarf wheat; it is sown in November (in Italy). The straw is dried and afterwards blanched with sulphur. This blanched straw is the material used in all industries of this kind." (*Sprenger.*)

21860. CANARIUM LUZONICUM (Blume) Gray. **Pili nut.**

From Manila, P. I. Presented by Mr. George A. Spooner, Pay Department, U. S. Army, Chicago, Ill. Received January 25, 1908.

"This nut is largely used in the Philippine Islands and East Indies for food. It is said that the flavor is finer when the meat is blanched and salted, after the manner in which salted almonds are prepared." (*Ralph A. Gould.*)

21861. DIMORPHOTHECA SPECTABILIS Schlechter.

From Barberton, Transvaal. Presented by Mr. George Thorncroft. Received January 18, 1908.

"Habitat: Grows on stony hills, altitude 6,000 feet. Flowers in September, with the first shower of rain. (We get no rain here from the end of March until August.) It is the handsomest of all our daisies." (*Thorncroft.*)

"The plant grows 30 to 45 centimeters high and has bright purple rays about 2.5 centimeters long and a purple disk." (*Schlechter.*)

21862 and 21863. SPERGULA ARVENSIS L. **Spurry.**

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received January 30, 1908.

21862. *Corn* or *Common.*

21863. *Giant.*

21864. DIOSCOREA DECAISNEANA Carr. **Yam.**

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received January 30, 1908.

21865. COLEUS AMBOINICUS Lour.

From Toco, Trinidad. Collected by Mr. O. W. Barrett in October, 1907.

21867. MEDICAGO SATIVA L. **Alfalfa.**

From Juab Valley, near Nephi, Utah. Purchased from Mr. Oliver Wilson. Received February 6, 1908.

Dry-Land.

21868 and 21869. ANDROPOGON SORGHUM (L.) Brot. **Kafir.**

From Chillicothe, Tex. Grown by Mr. A. B. Conner, season of 1907.

21868. *Black-Hull.* "Original selection made on farm of Mr. T. F. Moody, Canadian, Tex., in 1905, and grown in head-to-row plots at the Chillicothe Testing Station since that date." (*Conner.*)

21869. *Black-Hull.* "Original selection made on farm of Mr. Noblett, Chillicothe, Tex., in 1905, and grown in head-to-row plots at the Chillicothe Testing Station since that date." (*Conner.*)

21870. CITRUS DECUMANA (L.) Murr. **Pomelo.**

From Amoy, China. Presented by Mr. W. H. Wallace, manager, Hongkong-Shanghai Bank. Received February 7, 1908.

Amoy. "The *Amoy* pomelos are noted among Europeans and Americans along the coast of China for their excellent quality. According to Mr. Rea Hanna, formerly of the consulate at Amoy, this variety is equal in quality to the best Florida-grown varieties with which he is familiar." (*Fairchild.*)

21871 to 21874.

From Zichron-Jacob, Caiffa, Palestine. Presented by Mr. A. Aaronsohn. Received October 30, 1907.

21871. TRITICUM DICOCCUM Schrank. **Emmer.**

From above Medschoel esch-Schems.

21872. TRITICUM DICOCCUM Schrank. **Emmer.**

From vicinity of Rahle, between Raschaya and Katana. Altitude about 1,500 meters.

21873. TRITICUM MONOCOCCUM AEGILOPIOIDES Asch. & G.

From Rahle.

21874. HORDEUM SPONTANEUM C. Koch.

From Mount Tabor. "Soil calcareous." (*Aaronsohn.*)

21875 to 21932.

From Peking, Chihli, China. Received through Mr. F. N. Meyer, agricultural explorer for this Department, February 7, 1908.

A miscellaneous collection of seeds and cuttings, as follows:

21875. CASTANEA SATIVA Mill. **Chestnut.**

From Pangshan, Chihli, China. "(No. 833a, Nov. 24, 1907.) A wild chestnut found growing here and there in big groves on the rocky mountain slopes. The burrs containing the nuts are extraordinarily spiny. This chestnut may grow in regions where there is a slight rainfall and be utilized as a foresting tree. Chinese name *San li tse shu.*" (*Meyer.*)

21876. QUERCUS sp.

From Shutseshan, Chihli, China. "(No. 835a, Nov. 18, 1907.) Acorns of a chestnut oak, probably *Quercus chinensis.* Called by the Chinese *Siang tse shu.* They utilize the acorns for tanning and dyeing purposes, and also fatten hogs with them. It is a handsome tree, with long, serrated leaves, which remain on the tree for the greater part of the winter. Stands drought very well, but seems sensitive to great cold. May be of use as a foresting tree in the semiarid regions of the southwestern United States." (*Meyer.*)

21875 to 21932—Continued.

21877. JUGLANS REGIA SINENSIS C. DC. **Walnut.**

From Pangshan, Chihli, China. "(No. 836a, Nov. 24, 1907.) A wild walnut found growing here and there between bowlders. The nuts are not as sweet as the cultivated varieties, but otherwise there is little difference, except that the wild trees are not of as vigorous a growth as the cultivated ones." (*Meyer.*)

21878. MALUS BACCATA (L.) Moench. **Crab apple.**

From Shinglungshan, Chihli, China. "(No. 837a, Dec. 2, 1907.) A wild crab apple, the fruits of which are not larger than green peas. An excellent stock for all kinds of crab apples. Chinese name *San tin tse.* Scions sent under No. 183 (S. P. I. No. 21922)." (*Meyer.*)

21879. MALUS sp. **Crab apple.**

From Jehol, Chihli, China. "(No. 838a, Dec. 10, 1907.) A cultivated crab apple. Chinese name *Gei tang.* Scions sent under No. 195 (S. P. I. No. 21927)." (*Meyer.*)

21880. PYRUS CHINENSIS Lindl. **Pear.**

From Shinglungshan, Chihli, China. "(No. 839a, Dec. 2, 1907.) Seeds of a wild pear which grows here and there in big groves and assumes sometimes a large size, trunks 2 to 3 feet in diameter and 60 to 80 feet tall. May be utilized as grafting stock in northern regions. Scions sent under No. 184 (S. P. I. No. 21923)." (*Meyer.*)

21881. CELTIS sp. **Hackberry.**

From Pangshan, Chihli, China. "(No. 851a, Nov. 24, 1907.) Probably *Celtis bungeana.* A small tree with rather broad leaves, growing in rocky locations. Of use in gardens and parks in rather dry regions." (*Meyer.*)

21882. CELTIS sp. **Hackberry.**

From near Yenmenkwan, Chihli, China. "(No. 852a, Nov. 30, 1907.) Probably *Celtis bungeana.* Apparently the same as the preceding number (S. P. I. No. 21881)." (*Meyer.*)

21883. (Undetermined.)

From mountains of North China. "(No. 866a, Nov. 18 to Dec. 2, 1907.) A low shrub, 1 to 1½ feet high, flowering in early summer, with beautiful rosy flowers in short racemes; very floriferous. Grows in dry, rocky locations, covering sometimes whole mountain slopes. Well fitted for rockeries or as a bedding shrub in gardens in dry regions. Chinese name *Fan li hua.* Sent from Manchuria under No. 402a (S. P. I. No. 20127)." (*Meyer.*)

21884. LESPEDEZA sp. (?).

From Pangshan, Chihli, China. "(No. 867a, Nov. 20, 1907.) Probably *Lespedeza caraganae.* A rare shrub, 4 to 5 feet tall, found growing in rocky and sandy locations. Seems to like some shade. May be of use in sandy, dry regions." (*Meyer.*)

21885. LESPEDEZA sp.

From near Malanyu, Chihli, China. "(No. 868a, Nov. 29, 1907.) Probably *Lespedeza juncea.* A shrub forming many straight shoots, growing in sandy and rocky locations in the full sun. In Tsingtau it is extensively used for sand binding and for underwood in the Yemen government parks and nurseries. Sent also from eastern Siberia under No. 564a (S. P. I. No. 20335)." (*Meyer.*)

21886. LESPEDEZA sp.

From Shinglungshan, Chihli, China. "(No. 869a, Dec. 2, 1907.) Seeds of a leguminous, perennial herb found growing on very dry and rocky mountain slopes, having many slender, semierect stems which spring up in a tuft; very small, trifoliate leaves. May be of value on dry lands as sheep fodder, though the seed capsules are spiny when dry." (*Meyer.*)

21875 to 21932—Continued.

21887. LESPEDEZA sp.

From near Jehol, Chihli, China. "(No. 807a, Dec. 5, 1907.) Seeds of a leguminous, perennial herb found growing along very dry banks. Apparently a variety of No. 869a (S. P. I. No. 21886), but having much heavier and creeping stems, due perhaps to the location; otherwise the same remarks apply." (*Meyer.*)

21888. (Undetermined.)

From Pangshan, Chihli, China. "(No. 871a, Nov. 20, 1907.) An alfalfa-like plant. A leguminous, perennial herb growing in very dry and rocky places, throwing up a tuft of many slender, though very erect stems; small, trifoliate leaves and small racemes of very small, whitish flowers. Height 2½ to 3 feet. May be of value on dry land as a food for cattle." (*Meyer.*)

21889. FALCATA JAPONICA Oliver.

From mountains near Santchako, Chihli, China. "(No. 872a, Dec. 1, 1907.) Seeds of a Leguminosae of twining habit, similar to No. 617a (S. P. I. No. 20386). Of use as a fodder plant on land which is overrun with scrub, so as to give this bean support." (*Meyer.*)

21890. INCARVILLEA SINENSIS Lam.

From near Shinglungtang, Chihli, China. "(No. 874a, Dec. 4, 1907.) An herbaceous annual, bearing large, rose-red flowers in terminal racemes; finely pinnatifled leaves. Grows from 2 to 4 feet tall, often seen along new railroad embankments in Shansi. The leaves and stems are used by the Chinese as medicine, applied externally, when they have cold or rheumatism in their legs or knee joints." (*Meyer.*)

21891. (Undetermined.)

From near Shinglungtang, Chihli, China. "(No. 879a, Dec. 5, 1907.) An herbaceous, annual Labiate with bluish flowers containing a volatile perfume, like menthol; may be useful for extraction of this perfume. The Chinese use the plant medicinally for colds in the head, and it *does* clear when snuffed up through the nostrils in case of a cold. Seems to come close to the North American *Pycnanthemum linifolium* in containing so much menthol-like scent." (*Meyer.*)

21892. ARTEMISIA ANNUA L.

From Tientsin, Chihli, China. "(No. 885a, Oct. 7, 1907.) A biennial herb used for grafting large-flowered chrysanthemums upon when it throws up its flowering stem in the second year. Chinese name *Yu hou.*" (*Meyer.*)

21893. CHRYSANTHEMUM STIPULACEUM Moench. (CHRYSANTHEMUM SINENSE Sabine, 1825.) (ANTHEMIS STIPULACEA Moench, 1802.) **Chrysanthemum.**

From Pangshan, Chihli, China. "(No. 886a, Nov. 19, 1907.) Seeds of the original type of chrysanthemum, from which most of the cultivated ones have been derived; flowers vary in color from pure white to purple. Deserves to be naturalized as a wild flower in rocky localities. Used medicinally by the Chinese (like tea, when suffering from a cold). Chinese name *Hsu hua.*" (*Meyer.*)

21894. CHRYSANTHEMUM INDICUM L. **Chrysanthemum.**

From Pangshan, Chihli, China. "(No. 887a, Nov. 19, 1907.) An original type of chrysanthemum, from which probably the yellow varieties of cultivated chrysanthemums have been derived. Always yellow, though there is a slight variation in its shading. Used as a medicine by the Chinese, like the preceding number (S. P. I. No. 21893)." (*Meyer.*)

21895. ERAGROSTIS sp.

From Tungling, Chihli, China. "(No. 888a, Nov. 29, 1907.) An uncommon, graceful grass growing from 2½ to 3 feet tall; found along dry ditches." (*Meyer.*)

21875 to 21932—Continued.

21896. Arundinella anomala Steud.

From Tungling, Chihli, China. "(No. 889a, Nov. 29, 1907.) A tall, coarse grass, 3 to 5 feet tall, found growing here and there in large masses; of a spread-out growth. May be of use as a fodder grass." (*Meyer.*)

21897. Andropogon ischaemum L.

From Tungling, Chihli, China. "(No. 890a, Nov. 29, 1907.) A medium tall grass growing here and there on level stretches in large quantities." (*Meyer.*)

21898. Spodiopogon sibiricus Trin.

From Tungling, Chihli, China. "(No. 891a, Nov. 29, 1907.) A rare, very tall grass, 6 to 7 feet high, growing in solitary clumps." (*Meyer.*)

21899. Pennisetum compressum R. Br.

From near Yenmenkwan, Chihli, China. "(No. 892a, Nov. 30, 1907.) Seed of a rare grass growing in heavy clumps here and there along water courses." (*Meyer.*)

21900. Pennisetum flaccidum Griseb.

From near Lanshang, Chihli, China. "(No. 893a, Dec. 3, 1907.) A low grass, 1½ to 2 feet high, growing in vast quantities on sandy, level stretches." (*Meyer.*)

21901. Phaseolus vulgaris L. **Bean.**

From Pangshan, Chihli, China. "(No. 894a, Nov. 21, 1907.) A strange bean used as a vegetable." (*Meyer.*)

21902. Cucurbita pepo L. **Pumpkin.**

From Pangshan, Chihli, China. "(No. 895a, Nov., 1907.) A large pumpkin, used as a vegetable when boiled; also baked in the oven entire and used then as a delicatesse." (*Meyer.*)

21903. Citrullus vulgaris Schrad. **Watermelon.**

From Pangshan, Chihli, China. "(No. 896a, Nov. 21, 1907.) Said to be a white-meated watermelon of very good taste." (*Meyer.*)

21904. Citrus sp.

From Peking, Chihli, China. "(No. 897a, Dec. 24, 1907.) A large-fruited citrus, the fruits of which are sold as room perfumers. The meat is very bitter and sour and scarcely edible." (*Meyer.*)

21905. Citrus limonum Risso. **Lemon.**

From Peking, Chihli, China. "(No. 898a, Dec. 24, 1907.) A large, very juicy lemon, not too sour; the fruits are almost seedless and have a very thin rind. Purchased on the street." (*Meyer.*)

21906. Celosia argentea L. **Cockscomb.**

From Tsuichiachuang, Shantung, China. "(No. 900a, Nov., 1907.) A variety of cockscomb said to grow in a globular head; very rare. Sent to me by Rev. A. C. Moule, of Taian, Shantung." (*Meyer.*)

21907. Vitis sp.

From Pangshan, Chihli, China. "(No. 153, Nov. 20, 1907.) A Vitis bearing large, deeply lobed leaves and small clusters of bluish white berries. Grows in dry, rocky situations. May be of use as a cover plant for large rockeries or for planting on terraces, where the branches may hang down so as to create a better effect." (*Meyer.*)

21908. Amygdalus davidiana (Carr.) Dippel. **Peach.**

From Pangshan, Chihli, China. "(No. 154, Nov. 30, 1907.) A variety found growing in very dry and exposed places. Of use as a garden shrub in semiarid regions. Also an excellent stock for apparently all of the stone fruits." (*Meyer.*)

21875 to 21932—Continued.

21909. Berberis sp. **Barberry.**

From Pangshan, Chihli, China. "(No. 160, Nov. 20, 1907.) Probably *Berberis chinensis.* A low-growing barberry of a very spreading habit. Seems to be able to withstand drought extraordinarily well. Not highly ornamental, but may be of use for planting on very sterile and dry soils. The scarlet berries seem to remain a long time upon the shoots, and for this reason it may be found useful as a winter ornamental bush." (*Meyer.*)

21910. Diospyros kaki L. f. **Persimmon.**

From Pangshan, Chihli, China. "(No. 161, Nov. 21, 1907.) A very rare, delicious persimmon called *Siang shi tse.* Of medium size, 2 to 3 inches in diameter, flat, but not having a circular incision; of orange-red color; very thin skinned; has generally 3 to 6 seeds in its fruits; is of very sweet and fresh taste. Only one tree known to exist, that being near an old temple. Is not a shipper, but can be kept until February when handled carefully." (*Meyer.*)

21911. Pyrus chinensis Lindl. **Pear.**

From Pangshan, Chihli, China. "(No. 166, Nov. 23, 1907.) A round, hard pear of medium size. Has a high red blush and looks strikingly like an apple. Chinese name *Hong li,* meaning red pear. Can be kept until early summer." (*Meyer.*)

21912. Pyrus chinensis Lindl. **Pear.**

From Pangshan, Chihli, China. "(No. 167, Nov. 23, 1907.) A small pear of canary-yellow color; egg shaped with a long peduncle; hard meated, but very sweet and juicy; a good keeper. Chinese name *Mi li,* meaning honey pear." (*Meyer.*)

21913. Pyrus chinensis Lindl. **Pear.**

From Pangshan, Chihli, China. "(No. 168, Nov. 23, 1907.) A hard, round, apple-shaped pear of a russet color; of rather coarse texture; a good keeper and shipper. May be good for cooking purposes. Chinese name *Tang li.*" (*Meyer.*)

21914. Pyrus chinensis Lindl. **Pear.**

From Pangshan, Chihli, China. "(No. 169, Nov. 23, 1907.) A hard but juicy pear of medium size, barrel shaped, and of a pale straw-yellow color. A very good keeper and shipper. Chinese name *Ma li.*" (*Meyer.*)

21915. Malus sp. **Crab apple.**

From Pangshan, Chihli, China. "(No. 170, Nov. 23, 1907.) A sweet, white crab apple of flat shape, like the saucer peach; a rare variety; does not keep well. Chinese name *Sa kua.*" (*Meyer.*)

21916. Malus sp. **Crab apple.**

From Pangshan, Chihli, China. "(No. 171, Nov. 23, 1907.) A sour, red crab apple of flat shape, like the saucer peach. A rare local variety and like the preceding number (S. P. I. No. 21915) does not keep well. Chinese name *Ly tse.*" (*Meyer.*)

21917. Pyrus chinensis Lindl. **Pear.**

From Pangshan, Chihli, China. "(No. 175, Nov. 23, 1907.) A very thrifty growing pear, said to be a variety of No. 169 (S. P. I. No. 21914). Not named, however. All of these pears look more like apples than like pears so far as habits and general looks are concerned. The bark on the tree is smooth and on the younger branches even shining so as to absorb a minimum of heat during the winter and spring. These retarding qualities may be of much value in breeding experiments." (*Meyer.*)

21918. Pyrus chinensis Lindl. **Pear.**

From Tungling, Chihli, China. "(No. 177, Nov. 29, 1907.) A very thrifty form of the wild pear, used everywhere in the north as a grafting stock for the cultivated varieties of pears." (*Meyer.*)

21875 to 21932—Continued.

21919. Rhododendron sp.

From Shinglungshan, Chihli, China. "(No. 180, Dec. 2, 1907.) Probably *Rhododendron micranthum*. A small-leaved, semi-evergreen bush bearing small clusters of yellowish white flowers in early summer. Is always found growing at elevations from 3,000 to 8,000 feet." (*Meyer.*)

21920. Ulmus sp. **Elm.**

From Shinglungshan, Chihli, China. "(No. 181, Dec. 2, 1907.) An elm growing to be a tall tree, bearing broad leaves. The trees when young have corky wings all along their branches, which makes them look striking. Seems to thrive best in somewhat moist soil." (*Meyer.*)

21921. Crataegus pinnatifida Bunge. **Hawthorn.**

From Shinglungshan, Chihli, China. "(No. 182, Dec. 2, 1907.) A very hardy hawthorn with glistening white twigs; may be of use as a fence plant in semiarid regions." (*Meyer.*)

21922. Malus sp. **Crab apple.**

From Shinglungshan, Chihli, China. "(No. 183, Dec. 2, 1907.) The very hardy, small-fruited crab apple, upon which the Chinese graft their improved forms of crab apples. Chinese name *San tin tse*." (*Meyer.*)

21923. Pyrus chinensis Lindl. **Pear.**

From Shinglungshan, Chihli, China. "(No. 184, Dec. 2, 1907.) The fruits of these wild pear trees become edible after the heavy frosts, but are not particularly fine; the wood, though, is much wanted for the manufacture of printing blocks and for comb making. The trees might be grown in parks as ornamental, hardy trees. Planted in a clump they are very effective." (*Meyer.*)

21924. Prunus tomentosa Thunb. (?). **Cherry.**

From near Laushang, Chihli, China. "(No. 186, Dec. 3, 1907.) The wild bush cherry. A very hardy shrub of dense, bushy habit. May be of use in parks and gardens in semiarid regions. Can be propagated by budding on *Amygdalus davidiana* and by division, layering, and sowing. Chinese name *Shan ying tau*." (*Meyer.*)

21925. Hydrangea sp.

From near Tungying, Chihli, China. "(No. 187, Dec. 4, 1907.) A tall, bushy hydrangea, bearing many umbels of apparently white flowers. A rare shrub, found (only twice) in rocky locations along a water course." (*Meyer.*)

21926. Rhododendron sp.

From near Tungying, Chihli, China. "(No. 189, Dec. 4, 1907.) A tall, bushy rhododendron, perfectly deciduous, bearing medium-sized clusters of lilac flowers in early summer. Of use as a shrub in rockeries. Grows apparently between 4,000 and 7,000 feet elevation." (*Meyer.*)

21927. Malus sp. **Crab apple.**

From Jehol, Chihli, China. "(No. 195, Dec. 10, 1907.) Chinese name *Gei tang*. The fruits are as large as good-sized cherries, of dark red color with a bluish tinge. Of a very fresh, sour taste and make good preserves. Are grafted upon the wild crab apple. They seem to be able to withstand drought and extremes in temperature very well." (*Meyer.*)

21928. Pyrus chinensis Lindl. **Pear.**

From Jehol, Chihli, China. "(No. 196, Dec. 10, 1907.) A medium-sized pear of pale yellow color and of soft, melting meat. Can be kept quite a while when handled carefully. Is a rare local variety. Chinese name *Pei soo li*." (*Meyer.*)

21875 to 21932—Continued.

21929. PYRUS CHINENSIS Lindl. **Pear.**

From Jehol, Chihli, China. "(No. 197, Dec. 10, 1907.) A remarkable pear, being flat apple-shaped, of green-yellowish color; hard until spring, when it becomes melting; has a peculiar sour taste. Makes excellent preserves for use with game or fowl. Chinese name *Ta suan li*, meaning large, sour pear." (*Meyer.*)

21930. PYRUS sp. **Pear.**

From Jehol, Chihli, China. "(No. 198, Dec. 10, 1907.) A medium-sized pear; hard, but juicy and sweet; dark canary-yellow colored. A good keeper. A rare local variety. Chinese name *Ten li.*" (*Meyer.*)

21931. PYRUS sp. **Pear.**

From Jehol, Chihli, China. "(No. 199, Dec. 10, 1907.) A small-sized pear of apple shape; has soft, melting meat with an agreeable tart flavor; of yellow color, with rosy red blush. Not anything extra. Chinese name *Guarr li.*" (*Meyer.*)

21932. ULMUS DAVIDIANA Planch. **Elm.**

From near Jehol, Chihli, China. "(No. 201, Dec. 11, 1907.) An elm growing to be a medium-sized tree with a round, spread-out head; when young has two corky wings along its young branches; is not a common tree at all. Grows in very dry and exposed localities. May be of use as a park and garden tree in the cold-wintered, semiarid regions of the United States." (*Meyer.*)

21933. DIOSCOREA sp. **Yam.**

From Manila, P. I. Presented by Mr. William S. Lyon, through Mr. O. W. Barrett. Received February 11, 1908.

"It is entirely devoid of the gumminess so prized by the natives in such yams as 'Namé' and 'Tuguí.'" (*Lyon.*)

"*Raspberry.* This is a variety native to the virgin forests of Luzon and is never seen in cultivation on account of the difficulty of keeping the roots through the long dry season." (*Barrett.*)

21934. VIGNA CATJANG (Burm.) Walp. **Catjang.**

From Sydney, New South Wales, Australia. Presented by the Department of Agriculture. Received January 20, 1908.

Upright. "This pea is the most upright of any of the varieties originally from India. This same pea was received in 1902, as Agros. No. 1488, from New South Wales, they having received it from India in 1901." (*Nielsen.*)

21935. MEDICAGO SATIVA L. **Alfalfa.**

From Puno, Peru, near Lake Titicaca. Presented by Prof. Alberto L. Gadea, through Mr. Charles J. Brand. Received December, 1907.

Andean. "(P. L. H. No. 3262.) Grown at an altitude of 12,540 feet, 1907 crop." (*Brand.*)

21936. ANDROPOGON SORGHUM (L.) Brot. **Sorgo.**

From Guymon, Okla. Presented by Mr. A. L. Johnson, through Mr. C. R. Ball, agronomist, Sorghum Investigations of the Bureau of Plant Industry. Received February 7, 1908.

Gooseneck. (?) "*Mexican Turfless.* I have grown this variety one year in Texas and one year in Oklahoma; it came originally from Mexico and was so named because of its Mexican origin and the fact that it does not turf or clod the ground as other varieties do. It is very leafy, an abundant stooler, and reaches a height of 4.5 feet under my conditions." (*Johnson.*)

21937. ANDROPOGON SORGHUM (L.) Brot. **Kafir.**

From Chillicothe, Tex. Grown by Mr. A. B. Conner, at the Chillicothe Testing Station, season of 1907.

Black-Hull. "(Agros. No. 1700.) Grown as a selection since 1905 at Chillicothe, Tex., by Mr. A. B. Conner. Original seed from Bomen, New South Wales, Australia, presented by Mr. G. Maurice McKeown, manager, Wagga Experiment Farm; received June 15, 1903. Numbered February 11, 1908, for convenience in keeping records." (*Conner.*)

21938. MEDICAGO SATIVA L. **Alfalfa.**

From near Excelsior, Minn. Received through Mr. A. B. Lyman, February 6, 1908.

Grimm. Crop of 1907.

21939 to 21941.

From Pretoria, Transvaal, South Africa. Presented by Prof. J. Burtt Davy, government agrostologist and botanist, Transvaal Department of Agriculture. Received February 10, 1908.

21939. TRITICUM AESTIVUM L. **Wheat.**

Havemann.

21940. ANDROPOGON SORGHUM (L.) Brot. **Kafir.**

Red. (No. 5.)

21941. ANDROPOGON SORGHUM (L.) Brot. **Sorghum.**

White durra. From the Kabyle Country, Algeria, April, 1907.

21942. ASTRAGALUS SINICUS L.

From Yokohama, Japan. Presented by the Yokohama Nursery Company. Received February 10, 1908.

Giant.

21943. CEPHALOSTACHYUM PERGRACILE Munro. **Bamboo.**

From Northern Circle, U. B., India. Presented by Mr. J. Copeland, Conservator of Forests, through the Chief Conservator of Forests, Burma. Received February 15, 1908.

(See No. 21236 for description.)

21944. VICIA SATIVA L. **Common vetch.**

From Pullman, Wash. Grown by Mr. W. M. Evans in 1907. Received December, 1908.

"The above was grown from seed of C. V. P. No. 0449, which was originally picked out of rye from Fair Oaks, Cal." (*Nielsen.*)

21945. MEDICAGO SATIVA L. **Alfalfa.**

From Sextorp, Nebr. Purchased from Mr. Lewis Brott. Received February 15, 1908.

Dry-Land. "This seed was grown on the high plains of western Nebraska for about twelve years. This strain is promising on account of its drought and cold resisting qualities. Crop of 1907. No hay crop is taken off when it is desired to produce seed." (*Brand.*)

21946 to 21955.

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture. Received February 11, 1908.

21946. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

"*Zwarte kadelee.*"

21946 to 21955—Continued.

21947 to 21950. Dolichos lablab L. **Hyacinth bean.**

21947. "*Katj: Ieda.*" **21949.** "*Katj: Ypit idjo.*"

21948. "*Katj: Ypit.*" **21950.** "*Katj: Ypit poetih.*"

21951 to 21953. Stizolobium capitatum (Roxb.) Kuntze.

21951. Black-seeded variety. **21953.** "*Bengoek item.*"

21952. "*Bengoek poetih.*"

21954. Stizolobium hirsutum (Wight & Arn.) Kuntze.

21955. Stizolobium capitatum (Roxb.) Kuntze.

21956. Ananas sativus Schult. f. **Pineapple.**

From Quito, Ecuador. Presented by Hon. W. C. Fox, American minister. Received December 7, 1907.

Guayaquil. (?) "This plant is undoubtedly the so-called Guayaquil variety, although its exact habitat is 'El Milagro,' about 30 miles inland from Guayaquil. The Guayaquil is undoubtedly the finest pineapple I have ever tasted." (*Fox.*)

21957. Phragmites karka (Retz.) Trin.

From Sibpur, Calcutta, India. Presented by Capt. A. T. Gage, superintendent, Royal Botanic Garden. Received February 13, 1908.

"A grass very similar to *Phragmites communis*, but larger. Watt, Dictionary of Economic Products of India, vol. 6, p. 216, 1892, states that the stems are 8 to 12 feet high and are used for making baskets, chairs, hurdles, screens, and the tubes of 'hukahs.' Roxburgh, Flora of India, vol. 1, p. 348, 1832, states that the common Durma mats of Bengal are made of the stalks split open. Watt also says that according to Stewar a fiber is extracted from the upper part of the stems, and according to Atkinson the fiber of the flower stalks is manufactured into rope in the Kumaon Bhabar. Useful Plants of Japan, published by the Agricultural Society of Japan, 1895, p. 223, states that the grass is planted in water sides to protect mud from being washed away by waves, and that its young shoots are edible. Those produced in Udini village, of the Province of Setsu, are called Udono-yeshi and are very famous for their large and long stalks.

"Names in India: Hindu name, *Narkul;* Bengal name, *Nal;* Kumaon names, *Karka, Nal, Khaila.* Japanese names: *Jositake, Joosk* or *Sinagosa, Josi, Yoshi, Ashi.*" (*W. F. Wight.*)

21958. Panicum maximum Jacq. **Guinea grass.**

From Santiago de las Vegas, Cuba. Presented by Prof. H. Benton, chief, Department of Agriculture, through M. C. V. Piper. Received February 13, 1908.

21959. Berberis vulgaris japonica Regel.

From Jamaica Plain, Mass. Presented by Prof. C. S. Sargent, of the Arnold Arboretum. Received February 17, 1908.

For experiments in the breeding of barberries.

21960. Quercus cornea Lour.

From Hongkong, China. Presented by Mr. S. T. Dunn, superintendent, Botanical and Forestry Department. Received February 20, 1908.

(See No. 10633 for description.)

21961. Panicum plantagineum Link.

From Biloxi, Miss. Grown by Prof. S. M. Tracy, season of 1907. Received January, 1908.

"Seed from a single plant growing with No. 19158, Natal grass, at Biloxi, Miss. A very promising grass for that locality." (*Piper.*)

21962. Medicago sativa L. **Alfalfa.**

From Mecca, Cal. Presented by Mr. E. Brauckman, through Mr. J. M. Westgate. Received February 20, 1908.

"Seed from Arabian alfalfa, No. 12992, supposedly crossed with ordinary alfalfa which was grown alongside of it." (*Westgate.*)

21963 and 21964.

From Guatemala. Collected by Prof. W. A. Kellerman, Ohio State University, Columbus, Ohio. Presented through Dr. J. N. Rose, of the United States National Museum, Washington, D. C. Received February 20, 1908.

21963. Dahlia imperialis Roezl.

"(Kellerman's No. 7072; Rose's No. 08/17.) Plants of this species found growing 18 feet high." (*Kellerman.*)

21964. Beaucarnea guatemalensis Rose.

"(Kellerman's No. 7029; Rose's No. 08/16.) Tree 6 to 12 meters high, with a thickened bulbous base abruptly tapering into a slender stem 5 to 8 centimeters in diameter; the swollen base covered with corky bark 6 centimeters thick; upper part of stem smooth, with very thin bark; leaves numerous, slightly roughened on both surfaces, clustered at the top as in the common cultivated Beaucarneas, erect (?), broad at base (40 to 50 millimeters), 10 to 15 millimeters broad above the base and gradually tapering upward into a long filiform top 60 to 80 centimeters long, the margin entire; the male inflorescence an open panicle, 60 to 90 centimeters long; female inflorescence not seen; fruit 15 millimeters long, strongly three winged; wings thin, 4 to 5 millimeters broad.

"Collected halfway up the side of the Sierra de las Minas, opposite El Rancho, Guatemala, April 10, 1905 (Kellerman's No. 4320).

"This species belongs with *B. inermis* and *B. pliabilis*, but the fruit is broader winged than the former and the leaves are broader than in the latter." (*Rose.*)

21965. Trichilia emetica Vahl.

From Pretoria, Transvaal, South Africa. Presented by Prof. J. Burtt Davy, government agrostologist and botanist, Transvaal Department of Agriculture. Received February 24, 1908.

"This is one of our most ornamental evergreen shade trees, yielding an oil known as 'Maawa,' of which I understand there is some export from Portuguese East Africa to Marseille." (*Davy.*)

21966. Chayota edulis Jacq. **Chayote.**

From St. Rose, La. Presented by Mr. Henry McCall. Received February 24, 1908.

"A large, smooth, light green and very prolific variety raised in Louisiana, but original source unknown. To be distributed to growers in the South with the object of encouraging its culture for the market." (*Fischer.*)

21967 to 22023.

From Peking, Chihli, China. Received through Mr. F. N. Meyer, agricultural explorer for this Department, at the Plant Introduction Garden, Chico, Cal., February 12, 1908.

21967 to 22023—Continued.

A collection of seeds, as follows:

21967. CARAGANA CHAMLAGU Lam. (?).

From Chinanfu, Shantung, China. "(No. 766a, Sept. 22, 1907.) A shrub growing to be 6 to 10 feet tall, bearing small pinnate leaves, quite spiny, said to be loaded with yellow flowers in spring. Chinese name *Kuei tsi ching*. Used as a hedge plant, and as such may be utilized in the more arid regions of the United States, as it stands drought remarkably well." (*Meyer.*)

21968. GLEDITSIA HETEROPHYLLA Bunge.

From Lungtung, Shantung, China. "(No. 767a, Sept. 25, 1907.) Chinese name *San tsao ko*. A very spiny shrub or small tree growing in dry, rocky localities. May serve as a hedge plant in the southwestern regions of the United States." (*Meyer.*)

21969. ALBIZZIA sp.

From near Boshan, Shantung, China. "(No. 768a, Sept., 1907.) Chinese name *Pai yung shu*. A small ornamental tree, with finely pinnated leaves and flowers with pale pink stamens. Not very common. When old makes the same impression as the yellow locust, *Robinia pseudacacia*." (*Meyer.*)

21970. PISTACIA CHINENSIS Bunge. **Pistache.**

From Shantung Province, China. "(No. 769a, Sept. 16, 1907.) Chinese name *Huang lien tsun*. A very ornamental, graceful-growing tree which will be appreciated in the mild-wintered regions of the United States. Grows to a great age. The Chinese express out of the seeds an oil for burning purposes." (*Meyer.*)

21971. CORNUS MACROPHYLLA Wall.

From Lungtung, Shantung, China. "(No. 770a, Sept. 25, 1907.) A medium-sized tree, loaded at time of collecting with soapy, dark green berries, which are utilized by the Chinese for oil production, this oil being burned in lamps." (*Meyer.*)

21972. CELTIS sp. **Hackberry.**

From Lungtung, Shantung, China. "(No. 771a, Sept. 25, 1907.) A small-leaved Celtis, growing in rocky situations. Attains only a small size when growing wild; if planted and cared for, however, seems to grow much larger." (*Meyer.*)

21973. KOELREUTERIA PANICULATA Laxm. **Varnish tree.**

From Lungtung, Shantung, China. "(No. 772a, Sept. 25, 1907.) A variety of the bladderpod tree with much larger leaves than the ordinary variety. The young dried shoots with foliage left on them are used by the Chinese as a green dye." (*Meyer.*)

21974. VIBURNUM sp.

From Lungtung, Shantung, China. "(No. 773a, Sept. 25, 1907.) A rather large leaved Viburnum, bearing black berries in fall. Probably the same as Nos. 390a and 391a (S. P. I. Nos. 20115 and 20116). Of use as an ornamental park shrub." (*Meyer.*)

21975. VIBURNUM sp.

From near Taichingkong temple, Shantung, China. "(No. 774a, Aug. 10, 1907.) A small-leaved Viburnum, bearing red berries. Apparently a very rare shrub; only one specimen seen in all the mountains. Of use as a small shrub in gardens and parks." (*Meyer.*)

21976. VITEX INCISA Lam.

From Lungtung, Shantung, China. "(No. 775a, Sept. 25, 1907.) A sage which may prove to be a good plant for the arid Southwestern States. It is able to resist alkali remarkably well. The Chinese use it here and there for basketry manufacture, taking the annual shoots

21967 to 22023—Continued.

for this purpose. It has pretty blue flowers and is diligently visited by all kinds of bees, and as such might be grown in gardens as a semiornamental shrub and as a honey plant. When left alone, grows 20 feet tall." (*Meyer.*)

21977. Pteroceltis tatarinowii Maxim.

From Tuyung, Shantung, China. "(No. 776a, Sept. 25, 1907.) A large tree having a scaly whitish bark and small leaves." (*Meyer.*)

21978. Rhamnus sp.

From Lungtung, Shantung, China. "(No. 777a, Sept. 25, 1907.) A shrubby Rhamnus with very small leaves, bearing black berries in fall. Branches, quite spiny. Of use as a hedge plant in rocky situations." (*Meyer.*)

21979. Vitis sp. **Grape.**

From Boshan, Shantung, China. "(No. 779a, Sept. 18, 1907.) Chinese name, *Ya pu tao.* Bought on the market in Boshan; has small black berries, rather sour; grows wild here and there in the mountains. A good wine can be made from the berries, but a good wine from a Chinese point of view. Can be utilized as a stock in rather arid regions." (*Meyer.*)

21980. Vitis sp. **Grape.**

From Lungtung, Shantung, China. "(No. 780a, Sept. 25, 1907.) A rare wild grape bearing small clusters of black berries, which are quite sweet. Leaves deeply incised." (*Meyer.*)

21981. Vitis sp. **Grape.**

From Lungtung, Shangtung, China. "(No. 781a, Sept. 25, 1907.) A wild grape, probably *Vitis labrusca.* A vigorous grower, overgrowing here and there whole trees and shrubs." (*Meyer.*)

21982. Pyrus betulaefolia Bunge.

From near Mongtchou, Chihli (?), China. "(No. 782a, Oct. 2, 1907.) A wild pear. Chinese name *Tu li* or *Do li.* Bears fruits not larger than green peas. Is used all over the country as a stock on which to graft pears; the Chinese claim it can be slipped very easily. Stands alkali remarkably well, and grows sometimes on pure sand. May be of value to the United States in the alkaline districts as a stock. Is also rather a nice shade tree, growing to a large size and flowering most profusely." (*Meyer.*)

21983. Pyrus chinensis Lindl. **Pear.**

From Boshan, Shantung, China. "(No. 783a, Sept. 20, 1907.) Chinese name, *Tang li.* A wild pear bearing small, brown-colored fruits of an insipid taste. Has beautiful, large, glossy leaves. Probably has given blood to some of the Chinese varieties of pears." (*Meyer.*)

21984. Cydonia sp.

From Taichingkong temple, near Tsingtau, Shantung, China. "(No. 784a, Aug. 12, 1907.) Chinese name, *Hsau kua.* A large quincelike tree with a smooth bark; bears hard, round, yellow fruits, smelling like quinces, yet not like them. Is far from being common." (*Meyer.*)

21985. Pyrus chinensis Lindl. **Pear.**

From Chinanfu, Shantung, China. "(No. 785a, Sept. 22, 1907.) Seeds from some very large pears. May prove to be new types." (*Meyer.*)

21986. Crataegus sp. **Hawthorn.**

From Boshan, Shantung, China. "(No. 786a, Sept. 20, 1907.) Chinese name *San li huang.* A yellow-fruited hawthorn, growing sparsely in the mountains and sold here on the market." (*Meyer.*)

21967 to 22023—Continued.

21987. CRATAEGUS PINNATIFIDA Bunge. **Hawthorn.**

From Chingchowfu, Shantung, China. "(No. 787a, Aug. 22, 1907.) Chinese name *San li hong.* A small-fruited form of the Chinese hawthorn, much more sour than the larger varieties; is used by Chinese and foreigners as a preserve; is also a good substitute for cranberries and has the advantage that everybody can grow it in his own garden." (*Meyer.*)

21988. AMYGDALUS PERSICA L. **Peach.**

From eastern China. "(No. 788a, June–Sept., 1907.) Peach stones collected in different parts of eastern China. Some good types may appear among them." (*Meyer.*)

21989. AMYGDALUS PERSICA L. **Peach.**

From Feitcheng, Shantung, China. "(No. 789a, Sept. 1, 1907.) Some stones of the most famous peach of northern China, called the *Fei tao.* The fruits grow as heavy as 1 pound apiece and are pale yellowish colored, with a slight blush; meat white, except near the stone, where it is slightly red; taste excellent, sweet, aromatic, and juicy. Is a clingstone. Has extraordinary keeping and shipping qualities. The branches need propping up on account of the weight of the fruits. Prefers well-drained, light, deep loam of a decomposed rocky origin." (*Meyer.*)

21990. AMYGDALUS PERSICA L. **Peach.**

From Kianchau, Shantung, China. "(No. 790a, Aug. 13, 1907.) A flat, juicy, white peach of fine taste. Chinese name *Pai pien tao.*" (*Meyer.*)

21991. AMYGDALUS PERSICA L. **Peach.**

From Hangchow, Chehkiang, China. "(No. 791a, June 27, 1907.) A flat, red-meated peach, not very sweet in taste. Chinese name *Hung pien tao.*" (*Meyer.*)

21992. AMYGDALUS PERSICA L. **Peach.**

From near Chiningchou, Shantung, China. "(No. 792a, Sept. 6, 1907.) A flat, pale-fleshed peach, juicy but somewhat insipid. Grows in rather sterile localities." (*Meyer.*)

21993. ZIZYPHUS SATIVA Gaertn. **Chinese date.**

From Shantung Province, China. "(No. 793a, Aug.–Sept., 1907.) Seeds collected at different points. Perhaps good varieties will appear among them." (*Meyer.*)

21994. ZIZYPHUS SATIVA Gaertn. **Chinese date.**

From Chingchowfu, Shantung, China. "(794a, Aug. 22, 1907.) A fine, flat variety of jujube. Quite rare. Chinese name *Twen ku lu tsao.*" (*Meyer.*)

21995. ZIZYPHUS LOTUS (L.) Lam.

From near Boshan, Shantung, China. "(No. 795a, Sept. 19, 1907.) A wild form of the 'jujube,' used for stock for the large-fruited varieties. Grows in the driest and most sterile locations. A very bad weed. Chinese name *Suan tsao.*" (*Meyer.*)

21996. ZIZYPHUS SATIVA Gaertn. **Chinese date.**

From Chinanfu, Shantung, China. "(No. 796a, Sept. 22, 1907.) A flat, brown-colored variety of the jujube. Very sweet. Chinese name *Tun ku yu tsao.*" (*Meyer.*)

21997. PINUS BUNGEANA Zucc. **Pine.**

From Taiyuanfu, Shansi, China. "(No. 797a, May 11, 1907.) Chinese name *Kuotse.* Sold on the streets as delicacies. Said to come from northern Shansi." (*Meyer.*)

21967 to 22023—Continued.

21998. Dolichos lablab L. **Hyacinth bean.**

From Boshan, Shantung, China. "(No. 798a, Sept. 18, 1907.) Chinese name *Pai pien tau*. Are mostly eaten fresh; also are sliced like haricot beans and boiled. They will probably grow in the semiarid regions of the Southwestern States where the ordinary string beans fail. Mostly seen along the fields grown upon trellises." (*Meyer.*)

21999. Glycine hispida (Moench) Maxim. **Soy bean.**

From Boshan, Shantung, China. "(No. 799a, Sept. 18, 1907.) A rare variety of soy bean, sparsely grown near Boshan. Chinese name *Ta ha tau*. Used by the higher classes as a vegetable in soups." (*Meyer.*)

22000. Phaseolus radiatus L. **Mung bean.**

From near Tientsin, Chihli, China. "(No. 800a, Oct. 4, 1907.) Small yellow beans. Chinese name *Huang lu tou*. A very rare variety, used for making bean vermicelli and for sprouting purposes." (*Meyer.*)

22001. Medicago sativa L. **Alfalfa.**

From Tchangtchou, Chihli, China. "(No. 801a, Oct. 2, 1907.) A rather short growing variety of alfalfa. Said to resist alkali and drought very well. Chinese name *Mu su*." (*Meyer.*)

22002. Oryza sativa L. **Rice.**

From Tsintse, Shansi, China. "(No. 802a, May 6, 1907.) A hard, wet-land rice. Chinese name *Ying ta mi*. Grows in irrigated fields and is considered the very best rice of Shansi. Might be grown in the irrigated valleys of the Rocky Mountain States." (*Meyer.*)

22003. Triticum aestivum L. **Wheat.**

From Taiyuanfu, Shansi, China. "(No. 803a, May 11, 1907.) Chinese name *Hong mei*. The best red wheat to be had on the market. Thrives very well on alkaline lands. Is mostly grown as a winter wheat, though also in a limited degree as a summer crop. Stands irrigation well." (*Meyer.*)

22004. Triticum aestivum L. **Wheat.**

From Taiyuanfu, Shansi, China. "(No. 804a, May 11, 1907.) Chinese name *Pai mei*. The best white wheat for sale in Taiyuanfu. Grows well on strongly alkaline soils. Mostly grown as a winter wheat, though also as a summer crop. Is often irrigated when on high, dry land." (*Meyer.*)

22005. Avena nuda inermis (Körnicke) Asch. & Graeb.

From Taiying, Shansi, China. "(No. 805a, Apr. 18, 1907.) Mountain oats. Chinese name *Shi yu mei*. Grows on sterile mountain sides and at high elevations. When ground up the meal is manufactured into vermicelli, cakes, bread, and patties. Furnishes the ordinary food for the mountain people." (*Meyer.*)

22006. Fagopyrum tataricum (L.) Gaertn.

From Lingchin, Shansi, China. "(No. 806a, Apr. 17, 1907.) Mountain buckwheat. A strange kind of buckwheat used as a summer crop on high, sterile lands. The grains are ground up and vermicelli and flat cakes are made from the flour. Chinese name *Chou mei*." (*Meyer.*)

22007. Pisum arvense L. **Field pea.**

From Taiyuanfu, Shansi, China. "(No. 807a, May 11, 1907.) Grayish pea. Chinese name *Wau tou*. The peas are boiled in soups and used as a vegetable when sprouted; the young tops, too, are picked and serve as greens. Is able to thrive on strongly alkaline soils. May do well in the northern Rocky Mountain States." (*Meyer.*)

21967 to 22023—Continued.

22008. PHASEOLUS VULGARIS L. **Bean.**

From Taiyuanfu, Shansi, China. "(No. 808a, May 11, 1907.) Dwarf red bean. Chinese name *Hung tou.* Grows on rather alkaline soils: used green as haricot beans and also boiled, when dry, in soups. In warm localities can be grown twice during the season. May do well in the northern Rocky Mountain States." (*Meyer.*)

22009. AMYGDALUS DAVIDIANA (Carr.) Dippel.

From Tientsin, Chihli, China. "(No. 809a, Oct. 5 and 7, 1907.) Chinese name *Shan tao shu.* Sent under Nos. 728a and 9a (S. P. I. Nos. 21227 and 18262) on former occasions. Very resistant to droughts and alkaline matter. The Chinese use this tree as grafting stock for their flowering peaches and prunes; also as a stock for small bush cherries (*Ying tao*); even apricots are grafted on it. To be used as a stock for peaches, almonds, prunes, plums, etc." (*Meyer.*)

22010. ANDROPOGON SORGHUM (L.) Brot. **Sorghum.**

From Chingshan, Shantung, China. "(No. 810a, Aug. 12, 1907.) Chinese name *Chi tse ya tse.* A very rare dwarf variety of sorghum, not growing higher than 3 feet and making dense heads. Grows on shallow, sterile soils and matures much earlier than the taller growing varieties. May do well in the semiarid regions of the western United States." (*Meyer.*)

22011. ANDROPOGON SORGHUM (L.) Brot. **Sorghum.**

From near Chufoo, Shantung, China. "(No. 811a, Sept. 7, 1907.) A red-stemmed variety used in the manufacture of mattings, of which pretty specimens may be seen once in a while." (*Meyer.*)

22012. ANDROPOGON SORGHUM (L.) Brot. **Sorghum.**

From near Chungdiin, Shantung, China. "(No. 812a, Sept. 29, 1907.) A very tall growing, loose-headed variety of sorghum. The thrashed-out heads are utilized in broom manufacture. Stands alkali well." (*Meyer.*)

22013. GARDENIA JASMINOIDES Ellis.

From Chinanfu, Shantung, China. "(No. 813a, Aug. 26, 1907.) Seeds of a dye plant. Chinese name *Tsi tsse.* Used in giving the bean jelly and bean vermicelli a clear yellow color. Probably a southern plant." (*Meyer.*)

22014. IRIS ENSATA Thunb.

From Taiying, Shansi, China. "(No. 814a, Apr. 18, 1907.) A very low-growing Iris; can stand lots of cold, drought, and trampling over. Grows at high altitudes, 3,000 to 5,000 feet. Perhaps fit as a rockery plant." (*Meyer.*)

22015. IRIS ENSATA Thunb.

From Wutaishan, Shansi, China. "(No. 815a, Apr. 25, 1907.) Probably the same as No. 814a (S. P. I. No. 22014), but growing at an elevation of 8,000 feet above sea level." (*Meyer.*)

22016. LYCIUM CHINENSE Mill. **Matrimony vine.**

From Lungtung, Shantung, China. "(No. 816a, Sept. 28, 1907.) A matrimony vine growing in rocky hedges. Rather large, vivid red berries. May be of use as an ornamental porch vine." (*Meyer.*)

22017. SOLANUM sp.

From Boshan, Shantung, China. "(No. 817a, Sept. 19, 1907.) A rather ornamental Solanum bearing blue flowers, followed by scarlet berries. May be of use as a semiornamental vine." (*Meyer.*)

22018. ASPARAGUS sp.

From Boshan, Shantung, China. "(No. 818a, Sept. 19, 1907.) A wild, rather ornamental asparagus." (*Meyer.*)

21967 to 22023—Continued.

22019. HEMEROCALLIS sp.

From Laushan, Shantung, China. "(No. 819a, Aug. 5, 1907.) The flower buds of this fine, yellow, night-flowering lily are eaten by the Chinese, steamed like a vegetable, though very insipid." (*Meyer.*)

22020. CAPNOIDES sp.

From Taishan, Shantung, China. "(No. 820a, Sept. 10, 1907.) A yellow-flowering Capnoides growing at elevations from 3,000 to 5,000 feet. Quite ornamental when seen in its native haunts between rocks. May be of use as a rockery plant." (*Meyer.*)

22021. SESAMUM ORIENTALE L. **Sesame.**

From near Laoliang, Shantung, China. "(No. 821a, Sept. 30, 1907.) Seeds from a large-growing variety of this useful oil plant. Could be grown in the semiarid regions of the southwestern United States as a fine oil producer." (*Meyer.*)

22022. ARACHIS HYPOGÆA L. **Peanut.**

From Peking, Chihli, China. "(No. 824a, Oct. 22, 1907.) A small variety of peanut, said by the Chinese to contain much more oil than the larger ones. Is used all through the land as an appetizer, after having been steamed with salt water and then kept in weak brine. Quite nice to eat in that way." (*Meyer.*)

22023. SOLANUM MELONGENA L. **Eggplant.**

From Peking, Chihli, China. "(No. 825a, Nov. 5, 1907.) Golden eggplant. Chinese name *Chin cha.* Is often grown as an ornamental pot plant by the Chinese, bearing fruits just about the size of a small egg, which when young are white colored, later on turning into a golden yellow. If not known will be appreciated as a novelty." (*Meyer.*)

22024. WIDDRINGTONIA WHYTEI Rendle.

From Mlanji, Nyassaland, British Central Africa. Presented by Mr. Henry Brown, through Mr. O. W. Barrett. Received February 24, 1908.

"Seed taken from cedar trees 100 feet high and 14 feet in circumference. The tree is a fast grower and makes a handsome avenue tree. It grows at elevations varying from 2,000 to 8,000 feet. The wood is scented and very oily, burning like a candle when dry. It is used here for furniture making, etc." (*Brown.*)

22025. DOLICHOS LABLAB L. **Hyacinth bean.**

From Arlington Experimental Farm, Virginia. Grown during the season of 1907 under C. V. P. No. 0107. Received in autumn of 1907.

"Original seed presented by J. M. Thorburn & Co., New York.

"An early variety, which matured before all others at Arlington Farm. Promising for growing with corn for hay or silage." (*Piper.*)

22026. PANICUM MAXIMUM Jacq. **Guinea grass.**

From Saharunpur, Northwest Province, British India. Presented by Mr. A. C. Hartless, superintendent, Government Botanic Gardens. Received February 25, 1908.

22027. TRITICUM sp. **Wheat.**

From Lima, Peru. Presented by Mr. T. F. Sedgwick, director, Estación Experimental. Received February 25, 1908.

"*Cardial.* Seed of a large-kerneled wheat grown in the mountain districts of Peru." (*Sedgwick.*)

"This is either a Polish wheat or one of the large-kerneled durums, a question which could be determined on seeing it growing in the field. It is something that would be very interesting for some of our work in the intermountain districts; also for use in dry-land cereal work." (*Carleton.*)

22029. ASPARAGUS AFRICANUS Lam.

From Pretoria, Transvaal, South Africa. Presented by Prof. J. Burtt Davy, government agrostologist and botanist, Transvaal Department of Agriculture. Received February 18, 1908.

For the use of asparagus breeders.

22031 and 22032. STIZOLOBIUM CAPITATUM (Roxb.) Kuntze.

From Australia. Presented by Mr. J. H. Maiden, director, Botanic Gardens, Sydney, New South Wales, through Mr. C. V. Piper. Received February 21, 1908.

22031. *Black Mauritius* bean. From Sydney, New South Wales.

22032. *Black Mauritius* bean. From Kamerunga, Cairns, Queensland.

22033. GLYCYRRHIZA GLABRA L. **Licorice.**

From Patras, Greece. Presented by Hon. F. B. Wood, British consul. Received February 25, 1908.

"Licorice roots from the plants which grow wild in this country." (*Wood.*)

22034. LATHYRUS MARITIMUS (L.) Bigel. **Beach pea.**

From Woods Hole, Mass. Procured by Mr. A. J. Pieters, Hollister, Cal., in October, 1903, and presented to the Department December 27, 1907.

22035. TRIFOLIUM SUAVEOLENS Willd. **Fragrant clover.**

From Erfurt, Germany. Purchased from Mr. Ernst Benary. Received February 29, 1908.

"An annual clover sparingly used as an ornamental, but which may prove to be useful when used after the manner of crimson clover. It is perfectly hardy as far north as Washington." (*Piper.*)

22036 to 22049. PISUM ARVENSE L. **Canada field pea.**

From Brandon, Manitoba, Canada. Presented by Mr. James Murray, experimental farm, through Mr. C. V. Piper. Received February 28, 1908.

22036. *Agnes.*

22037. *Archer.*

22038. *Arthur.*

22039. *Chancellor.*

22040. *Daniel O'Rourke.*

22041. *Gregory.*

22042. *Mackay.*

22043. *Nelson.*

22044. *Paragon.*

22045. *Picton.*

22046. *Prince.*

22047. *Prince Albert.*

22048. *Victoria.*

22049. *Wisconsin Blue.*

22050. VIGNA UNGUICULATA (L.) Walp. **Cowpea.**

Grown at Amarillo, Tex., by Mr. A. H. Leidigh, Grain Investigation Experiment Farm, season of 1907.

Turney's Black-Eye. "Original seed procured from Mr. Turney, Channing, Tex., through Mr. Leidigh, spring of 1905." (*Conner.*)

22051 to 22055. VIGNA UNGUICULATA (L.) Walp. **Cowpea.**

Grown at Arlington Experimental Farm, Virginia, season of 1907.

22051. *Speckled Crowder.*

"(S. Lab. No. 51136.) Original seed procured from Mr. J. B. Bremie, Tazewell, S. C., through the Seed Laboratory, spring of 1907." (*Nielsen.*)

22051 to 22055—Continued.

22052. *Black Crowder.*

"(S. Lab. No. 52460.) Original seed procured from Mr. Simeon Fippin, R. F. D. No. 4, Cookville, Tenn., through the Seed Laboratory, spring of 1907." (*Nielsen.*)

22053. Near *Michigan Favorite.*

"(S. Lab. No. 51580.) Original seed procured from Mr. T. M. Marshall, R. F. D. No. 4, Walnut Cove, N. C., through the Seed Laboratory, season of 1907." (*Nielsen.*)

22054. *Volunteer.*

"Original seed grown by Mr. J. P. Hogan, Robinsonville, Miss. Presented to the Department by Mr. Joseph Vaulx, Nashville, Tenn., who procured the seed April 16, 1907.

"This pea has been grown near the mouth of the Arkansas River in Arkansas and across the Mississippi River in Mississippi for at least forty years, having volunteered from year to year in all that time. It is apparently very prolific." (*Nielsen.*)

22055. *Volunteering Iron.*

"Originally planted on Arlington Experimental Farm for seed in 1904, and has volunteered from year to year, this seed being saved in the fall of 1907. This is the only cowpea which has been known to volunteer at Arlington Farm, and may prove of value on that account." (*Nielsen.*)

22058 and 22059. HORDEUM spp. **Barley.**

From Madison, Wis. Presented by Prof. R. A. Moore, Agricultural Experiment Station. Received March 2, 1908.

22058. HORDEUM DISTICHON ERECTUM Schubl.

Primus. Grown from No. 19779.

22059. HORDEUM DISTICHON NUTANS Schubl.

Prinsess. Grown from No. 19780.

22060. ZEA MAYS L. **Corn.**

From the Esperanza district, Puebla, Mexico. Secured by Prof. H. Pittier, of the Bionomic Investigations, Bureau of Plant Industry. Received February, 1908.

Drought-Resisting. "A variety cultivated on the high plateau between Mexico City and Orizaba, in a very dry climate, with little rain and subject to strongly marked extremes of temperature. An excellent type, producing medium-sized ears with very small cobs. Should be well adapted for the semiarid districts of the Southwest." (*Pittier.*)

22061 to 22075.

From Hilo, Hawaii. Presented by Mr. L. C. Lyman, principal, Hilo Boarding School, through Mr. O. W. Barrett. Received March 4, 1908.

The following rhizomes:

22061 to 22065. MUSA spp. **Banana.**

22061. *Elele.*

22062. *Manaiula* or *Malaiula.*

22063. *Bolabola* or *Kusai.*

22064. *Iholena.*

22065. *Acae* or *Striped.*

22066 to 22075. COLOCASIA spp. **Taro.**

22066. *Ulaula Kumu.*

22067. *Makaua.*

22068. *Ohe.*

22069. *Ulaula palili.*

22061 to 22075—Continued.

22066 to 22075—Continued.

22070. *Pikokea.*
22071. *Maua melemele* or *Maua ulu.*
22072. *Wehewa.*
22073. *Ulaula uahi apele.*
22074. *Ahakea.*
22075. *Papa pueo.*

22076. TOONA CILIATA Roem.

From Ventimiglia, Italy. Presented by Mr. Alwin Berger, La Mortola. Received February 11, 1908.

"A large, nearly evergreen tree of rapid growth, similar in habit to *Ailanthus glandulosa*. A good tree for avenues in California, etc." (*Berger.*)

22077 to 22079. PISUM ARVENSE L. **Field pea.**

Grown at Pullman, Wash., season of 1907.

22077.

(C. V. P. No. 0396.) Received as *Pisum thebaicum* from Madrid Botanic Gardens.

22078.

(C. V. P. No. 0451.) Received as *Pisum abyssinicum* from Royal Botanic Gardens, Dublin, Ireland.

22079. *Peluschka.*

(C. V. P. No. 0456.) From Germany.

22081. CHRYSANTHEMUM sp.

From Yokohama, Japan. Purchased from the Yokohama Nursery Company. Received March 3, 1908.

"Seed specially gathered by Tanehan, the famous chrysanthemum show gardener at Dangozaka, Tokyo. The seed is sown about the spring equinoxes (Mar. 19) here. About 10 per cent is said to germinate." (*S. Iida.*)

22082. MACADAMIA TERNIFOLIA F. Muell.

From Sydney, New South Wales, Australia. Presented by Mr. J. H. Maiden, director of the Botanic Gardens. Received at the Plant Introduction Garden, Chico, Cal., April 19, 1907.

(P. I. G. No. 5336. For description see S. P. I. No. 18382.)

22083 to 22297. NICOTIANA spp. **Tobacco.**

From Portici, Italy. Presented by Dr. O. Comes, Royal School of Agriculture. Received February, 1908.

22083 to 22100. [a] NICOTIANA RUSTICA L.

22083. Var. TEXANA SUBCORDATA.
22084. Var. BRASILIA CHLORANTHA.
22085. Var. BRASILIA OBLONGIFOLIA (Hungary).
22086. Var. HUMILIS ROTUNDIFOLIA.
22087. Var. ROTUNDIFOLIA.
22088. Var. JAMAICENSIS ROTUNDIFOLIA.

[a] The nomenclature is that of Professor Comes as given in his pamphlet entitled Prospetto delle razze di tabacchi, which is an extract from the volume La R. Scuola Superiore di Agricoltura in Portici nel passato e nel presente. This name could not be found in the above-mentioned publication and it was taken from the label on the seed.

22083 to 22297—Continued.

22083 to 22100—Continued.

22089. Var. BRASILIA ROTUNDIFOLIA.

22090. Var. SCABRA OVATIFOLIA.

22091. Var. HUMILIS OVATIFOLIA.

22092. Var. BRASILIA OBLONGIFOLIA.

Brazile selvaggis.

22093. Var. JAMAICENSIS OVATIFOLIA.

22094. Var. OBLONGIFOLIA.

22095. Var. ASIATICA ROTUNDIFOLIA.

22096. Var. ASIATICA OVATIFOLIA.

22097. Var. TEXANA OVATIFOLIA (Calcutta).

22098. Var. TEXANA OVATIFOLIA SENEGALENSIS.

22099. Var. HUMILIS OBLONGIFOLIA.

22100. Var. BRASILIA OBLONGIFOLIA.

22101. NICOTIANA ALATA Link & Otto.

22102. NICOTIANA BIGELOVII ANGUSTIFOLIA.

22103. NICOTIANA GLUTINOSA L.

22104. NICOTIANA NOCTIFLORA ALBIFLORA.

22105. NICOTIANA QUADRIVALVIS Pursh.

22106. NICOTIANA SILVESTRIS Speg. & Comes.

22107 to 22297. NICOTIANA TABACUM L.

22107. Var. CALYCIFLORA.

22108. Var. FRUTICOSA BRASILENSIS MACROPHYLLA.

Nepal.

22109. [a] Var. FRUTICOSA ANGUSTIFOLIA.

22110. Var. FRUTICOSA BRASILENSIS HAVANENSIS.

Carabobo.

22111. Var. FRUTICOSA BRASILENSIS HAVANENSIS MACROPHYLLA.

Persician.

22112. Var. FRUTICOSA BRASILENSIS HAVANENSIS MACROPHYLLA.

Pravista.

22113. Var. FRUTICOSA BRASILENSIS LANCIFOLIA HAVANENSIS MACROPHYLLA.

Karchiaku.

22114. Var. FRUTICOSA BRASILENSIS LANCIFOLIA HAVANENSIS MACROPHYLLA.

Adakuvilatta.

22115. Var. FRUTICOSA BRASILENSIS LANCIFOLIA.

China.

22116 to 22123. Var. LANCIFOLIA BRASILENSIS HAVANENSIS.

22116. *Toolde.*

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22083 to 22297—Continued.

22107 to 22297—Continued.

22116 to 22123—Continued.

22117. *White Burley.*

22118. *Kuchivilatti.*

22119. *Kentucky.*

22120. *Cattaro.*

22121. *Brasile beneventano.*

22122. [a] *Little Orinoco.*

22123. [a] *Sweet Orinoco.*

22124 to 22129. Var. BRASILENSIS HAVANENSIS.

22124. [a] *Arumakappal.*

22125. [a] *Habana.*

22126. *Bahia.*

22127. [a] *Havana* (Plata).

22128. *San Paolo* (Brazil).

22129. *Isere.*

22130 to 22150. Var. BRASILENSIS HAVANENSIS MACROPHYLLA.

22130. *Maryland.*

22131. [a] *Avanetto riccia.*

22132. [a] *Avanetto.*

22133. [a] *Czetnek* (Muscatell).

22134. *Goundi.*

22135. [a] *Persian.*

22136. [a] *Hungary.*

22137. *Beni-Schafom.*

22138. *Granville.*

22139. *Brazilian.*

22140. [a] *Campetana* (Carpanè).

22141. *Conception.*

22142. *Florida.*

22143. *Uganda.*

22144. *Bona cabot.*

22145. *Adrianopolis.*

22146. [a] *Lamia.*

22147. *Capo Bona speranza.*

22148. *Chebli.*

22149. *Szegedin.*

22150. [a] *Aranone.*

22151. Var. BRASILENSIS FRUTICOSA HAVANENSIS MACROPHYLLA. *Latakia.*

22152. Var. BRASILENSIS HAVANENSIS VIRGINICA.

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22083 to 22297—Continued.

22107 to 22297—Continued.

22153 to 22158. Var. VIRGINICA HAVANENSIS BRASILENSIS.

22153. *Hester.*

22154. [a] *Virginia Bright.*

22155. *Lacks.*

22156. *Big Orinoco.*

22157. *Prior.*

22158. *White Orinoco.*

22159. Var. VIRGINICA BRASILENSIS HAVANENSIS LANCIFOLIA.

Famous.

22160. Var. VIRGINICA BRASILENSIS HAVANENSIS MACROPHYLLA.

Hyco.

22161 to 22166. Var. HAVANENSIS MACROPHYLLA.

22161. *Havana.*

22162. *Kadoe* (Java).

22163. *Bezoeki* (Java).

22164. *Loemadjang.*

22165. *Pekalongan* (Java).

22166. *Honduras.*

22167. [a] Var. HAVANENSIS ANGUSTIFOLIA BRASILENSIS MACROPHYLLA.

Shiraz (Persia).

22168 to 22173. Var. MACROPHYLLA HAVANENSIS.

22168. *Kawala.*

22169. *Curco aromatico.*

22170. *Ayasoluk.*

22171. *Xanthi Yaka.*

22172. *Varinas.*

22173. *Venezuelan.*

22174. Var. MACROPHYLLA HAVANENSIS BRASILENSIS.

Almyros.

22175. Var. MACROPHYLLA HAVANENSIS BRASILENSIS.

Karditza.

22176. Var. MACROPHYLLA PURPUREA.

22177. *Saloniki.*

22178. *Neder Betuwe.*

22179. *Mirodatos.*

22180. *Doniaku Chodiaku.*

22181. *Portorico.*

22182. *Schaufeltabak.*

22183. [a] *Tenedie taka.*

22184. [a] *Secco grande cicatrice.*

22185. *Chilena grande d'Ità* (Paraguay).

22186. *Doxato* (Drama).

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22083 to 22297—Continued.

22107 to 22297—Continued.

22187. *Hercegovina Trebinje.*

22188. *Ile-et-Vilaine.*

22189. *Pas de Calais.*

22190. [a] *Friedrick.*

22191. [a] *Paraguay.*

22192. [a] *Sumatra.*

22193. *Remedios.*

22194. *Partidos.*

22195. [a] *Over Betuwe.*

22196. *Verpelet.*

22197. *Neder Veluwe.*

22198. *Spitzblättrige.*

22199. *Spaza.*

22200. *Sofades.*

22201. *Chilena piccola d'Itd* (Paraguay).

22202. *Sumatra Deli* (Java).

22203. *Cannella Villa-Rica* (Paraguay).

22204. *Baffra.*

22205. *Salento.*

22206. *Ezeloor.*

22207. *Argos.*

22208. *Maas en Vaal.*

22209. *Sardegna rigadio.*

22210. *Tennessee Red.*

22211. *Singapur.*

22212. *Ecuador.*

22213. [a] *Sarg. di Fersala.*

22214. *Cannella d'Itd.*

22215. *Samsun.*

22216. *Samsun.*

22217. [a] *Manilla gele.*

22218. [a] *Over Veluwe.*

22219. *Buhlerthaler.*

22220. *Yedarit.*

22221. *Arby turkish.*

22222. *Valikappal.*

22223. *Katarumona.*

22224. *Friedrichsthaler.*

22225. *Hercegovina Ljubuski.*

22226. *Appelterre.*

22227. *Grammont.*

22228. *Tuckahoe.*

22229. *Dragon.*

22230. *Haute Saone.*

22231. *Hercegovina Stolach.*

22232. [a] *Manilla groena.*

22233. *Pumphala.*

22234. *Brandley.*

22235. *Granville Yellow.*

22236. *Comstock.*

22237. *Choice Havana.*

22238. *Tabac du Lot.*

22239. *Tabac du Nord.*

22240. *Big Orinoco.*

22241. *Cuban Seed Leaf.*

22242. *Valam.*

22243. *Moro di Cori.*

22244. *Evans.*

22245. *Goock.*

22246. *Bonanza.*

22247. *Northeimer.*

22248. *Gold Finder.*

22249. *Safran.*

22250. *Blue Prior.*

22251. *Pumpelly.*

22252. *Tilly.*

22253. *Missouri Seed Leaf.*

22254. *Connecticut Seed Leaf.*

22255. *Rhodus.*

22256. *General Grant.*

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[a] The nomenclature is that of Professor Comes as given in his pamphlet entitled Prospetto delle razze di tabacchi, which is an extract from the volume La R. Scuola Superiore di Agricoltura in Portici nel passato e nel presente. This name could not be found in the above-mentioned publication and it was taken from the label on the seed.

22083 to 22297—Continued.

22107 to 22297—Continued.

22257. *One Sucker.*

22258. *Premium.*

22259. *Kediric* (Java).

22260. *Deli Sumatra* (S. Paolo, Brazil).

22261. *Bullion.*

22262. *Missouri.*

22263. *Cuba.*

22264. *Doniaku.*

22265. *Szulok.*

22266. *Pennsylvania Seed Leaf.*

22267. *Sterling.*

22268. *Havana Seed Leaf.*

22269. *Landreth.*

22270. *Foglia grande di Villa-Rica* (Paraguay).

22271. *Virginia Dienze.*

22272. *Elsasser.*

22273. *Nepal.*

22274. [a] *Monikappal.*

22275. *China* (China).

22276. [a] *Secco nodo corto.*

22277. *Monnaikappal.*

22278. *Vuelta Abajo.*

22279. *Hoonan.*

22280. *Pichai di Villa-Rica* (Paraguay).

22281. *Florida Seed Leaf.*

22282. *Deli.*

22283. *Flanagan.*

22284. *Oak Hill Yellow.*

22285. *Conqueror.*

22286. *Best Prior.*

22287. *Havana* (Cuba).

22288. *Oburg.*

22289. *Clardy.*

22290. *Big Havana.*

22291. *Yellow Monmouth.*

22292. *Xanthi Kawala.*

22293. *Secco Sardegna.*

22294. *Karnukappal.*

22295. *Climax.*

22296. *Tabac del Lede.*

22297. *Lot-et-Garonne.*

22298. Canavali sp.

From Jaal, Luzon, P. I. Presented by Dr. H. M. Smith, Deputy Commissioner of Fisheries, Department of Commerce and Labor, Washington, D. C. Received March 3, 1908.

"A variety of bean which grows in hot, dry, sandy soil in various parts of Luzon, the vines attaining a length of 20 feet and having an abundance of large, succulent leaves." (*Smith.*)

22299 to 22301. Andropogon sorghum (L.) Brot.

From Monmouth, Ill. Presented by Mr. Samuel H. Weed, through Mr. C. V. Piper. Received February, 1908.

22299. Dark red hulled.

22300. Red hulled.

22301. Yellow hulled.

"A sweet or saccharine broom corn or broom sugar cane produced by hybridization and selection for seven years." (*Weed.*)

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22302. ORYZA SATIVA L. **Rice.**

From Venice, Italy. Presented by Consorti Sullam. Received March 11, 1908.

"Seeds of Spanish rice." (*Sullam.*)

22303 to 22305. HORDEUM spp. **Barley.**

From Svalöf, Sweden. Purchased from the Allmänna Svenska Utsädesaktiebolaget. Received March 12, 1908.

22303. HORDEUM DISTICHON ERECTUM Schubl.

Primus.

22304. HORDEUM DISTICHON NUTANS Schubl.

Prinsess.

22305. HORDEUM DISTICHON ERECTUM Schubl.

Svanhals.

22306. AVENA SATIVA L. **Oat.**

From Svalöf, Sweden. Presented by the Allmänna Svenska Utsädesaktiebolaget. Received March 12, 1908.

Victory. "This is the variety which of all our new races has given the highest yield." (*Allmänna Svenska Utsädesktiebolaget.*)

22308 to 22312.

From Shanghai, Kiangsu, China. Presented by Rev. J. M. W. Farnham, Chinese Tract Society. Received March 11, 1908.

22308. ZEA MAYS L. **Corn.**

"A peculiar kind of corn. There are several colors but they are said to be all the same variety. The corn is much more glutinous than other varieties so far as I know and may be found to be of some use, perhaps as porridge." (*Farnham.*)

22309. ORYZA SATIVA L. **Rice.**

"Seeds of a glutinous rice which we use for breakfast porridge and the like. I am told they sow it two weeks earlier than other rice, which would necessitate planting it about March 8. The Chinese hang this seed (paddy) in a bag in water—say in a tub—exposed to the sun and air till it sprouts, and then sow it thick in the mud of a small pond, the mud having been fertilized with ashes and carefully prepared before the water is turned on. Here, a little more than covered with water, it is allowed to grow until from 4 to 6 inches tall. It is then taken up in small clusters and set out in the rice fields, the mud having been prepared and covered with water the same way. I suppose the Americans have as good or better methods." (*Farnham.*)

22310. PHASEOLUS ANGULARIS (Willd.) W. F. Wight. **Adzuki bean.**

Red.

22311. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

Black. "Similar to *Nuttall* but larger." (*Neilsen.*)

22312. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

Yellow.

22313 to 22315. ZEA MAYS L. **Corn.**

From Buitenzorg, Java. Presented by Dr. M. Treub, director of the Department of Agriculture. Received February 11, 1908.

22313. "*Madaera.*"

22314. "*Menado.*"

22315. "*Favaansch.*"

22316. Operculina tuberosa (L.) Meissn.

From Miami, Fla. Received through Mr. Ernst A. Bessey, pathologist in charge of Subtropical Laboratory and Garden, March 14, 1908.

"Grown from S. P. I. No. 17835. This is a large ornamental vine belonging to the morning glory family. It is a vigorous grower, producing plants sometimes 30 to 50 feet long. The stems are woody and often in two years reach a thickness of one's arm. The flowers are large, yellow in color, and borne with great profuseness, making the plant very ornamental at the flowering period. It is grown to a limited extent around Miami and, if not already introduced there, may find favor in parts of California and other places where frost does not occur. This seed was obtained from a vine at the Subtropical Laboratory and Garden." (*Bessey.*)

22317 to 22322. Glycine hispida (Moench) Maxim.

Soy bean.

From Erfurt, Germany. Purchased from Haage & Schmidt. Received March 16, 1908.

22317. Probably *Butterball.*

22318. "*Giant Yellow.*" Probably *Amherst.*

22319. Brown.

22320. *Samarow.* Like No. 17260.

22321. Probably *Cloud.*

22322. "*Early Black* from Podolia." Probably *Buckshot.*

22323 and 22324.

From Fort Sandeman, Baluchistan. Received from Lieut. Col. G. C. French, I. A., political agent in Zhob, through Prof. E. P. Stebbing, imperial forest zoologist to the Government of India, Calcutta, India, March 11, 1908.

22323. Pistacia khinjuk Stocks. **Pistache.**

22324. Olea ferruginea Royle. **Olive.**

"Tree 30 to 50 feet high. The wood is hard and is highly prized for turning and for agricultural implements. It takes a high polish. An oil is extracted from the fruit." (*Brandis, For. Fl. Ind.*, p. 307.)

22325 to 22332. Andropogon sorghum (L.) Brot. **Durra.**

From Khartoum, Sudan, Africa. Presented by Mr. R. Hewison, agricultural inspector, agricultural and lands department, Sudan government, through Mr. C. V. Piper. Received March 16, 1908.

"Representative durras, or at least not kafirs; some may prove not to belong to the durra group as we understand it." (*C. R. Ball.*)

Seed of the following, with the localities in which they are commonly found. Varietal description, by Mr. C. R. Ball.

22325. *Kassabi.* Singa and Wad Medani, Blue Nile.

Probably identical with the "durra beda" of Egypt.

22326. *Hegari.* Singa and Wad Medani, Blue Nile.

22327. *Mugud.* Wad el Fahl, Blue Nile.

22328. *Feterita.* All over the durra area in the Sudan.

Seed is like No. 19517.

22329. *Fiki Mistahi.* Singa, Blue Nile.

22330. *Wad Akar.* Karkog, Blue Nile.

22331. *Nab el Tor.* Blue Nile.

22332. *Homeizi Asfar.* Singa, Blue Nile.

Seed is like Agros. No. 1456, *Hamaisee*, from the Sudan.

22333 to 22337. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

Grown at Arlington Experimental Farm, Virginia, season of 1907. Received March 19, 1908.

22333. *Baird.*

"This variety was mixed with *Brownie* when received from Pingyang, Korea. This mixture was given S. P. I. No. 6414. The two varieties were grown together under these numbers, 9417, 17256, and Agros. No. 1542, respectively. The two varieties were separated in the 1907 seed from Arlington Farm, and *Baird* given the above new number, *Brownie* remaining as No. 17256." (*Nielsen.*)

22334. Flat black.

"Received from Mr. H. B. Derr, Agricultural Experiment Station, Champaign, Ill. The original source of the seed is not known. It is quite similar in growth to *Nuttall*, but the seed is not the same shape, being flatter and larger." (*Nielsen.*)

22335. Yellow.

"Received from Mr. H. B. Derr, Agricultural Experiment Station, Champaign, Ill., where it was grown as *Illinois Medium Yellow*. It is very similar to *Hollybrook*, and perhaps is the same, but appears different on account of having been grown farther north." (*Nielsen.*)

22336. *Guelph.*

"Received from Mr. H. B. Derr, Agricultural Experiment Station, Champaign, Ill. Original seed was procured from the Agricultural Experiment Station, Wooster, Ohio." (*Nielsen.*)

22337. *Guelph.*

"Received from Mr. H. B. Derr, Agricultural Experiment Station, Champaign, Ill. Original seed was procured from the Agricultural Experiment Station, Fayetteville, Ark." (*Nielsen.*)

22338. CAPSICUM ANNUUM L. **Pepper.**

From Houston, Tex. Presented by Mr. J. Milton Howe, 204 Commercial National Bank Building. Received March 12, 1908.

"*Jalapa.* This pepper has a medium-sized, heavy-fleshed pod and is principally used for pickling. In its pickled condition it is very much prized by both Mexicans and visiting Americans. At present, I am importing them direct (from Mexico) for my own use and the use of my immediate friends. They take so well that I feel confident that there is an opening for their introduction into this country.

"The pickling process is apparently a brine followed by packing in vinegar." (*Howe.*)

22341. PUERARIA THUNBERGIANA (Sieb. & Zucc.) Benth. **Kudzu.**

From New York, N. Y. Purchased from J. M. Thorburn & Co. Received March 20, 1908.

"Kudzu is a large-leaved, very rapid growing, woody, leguminous vine, native to Japan. It succeeds well in every part of the United States where it has been tried, and where the summers are warm grows with great luxuriance. It is a most excellent vine for arbors or to produce a tropical effect by growing over low trees. In Japan a valuable fiber is made out of the stems, and from the large roots a fine quality of starch is extracted.

"Kudzu also furnishes abundant and nutritious forage, and should be largely experimented with for this purpose. In Japan it is grown on rough, rocky land or steep hillsides that can not be cultivated. In this country it should also be tested on lands too poor to be cultivated with profit. Kudzu being a legume will add nitrogen to the soil in addition to producing forage, and if at any future time it should be desirable to clear the land the starch crop of the roots will probably yield more than the cost. Kudzu may be used

22341—Continued.

either for pasturage or as green feed, though hay can be made of it. It will probably be best used as pasture and it is desirable to have two such pastures to be browsed alternately.

"*Directions for planting:* The seed should be started in a seed bed and the plants transplanted after they are well rooted. They should be planted 10 to 20 feet apart. The first season they will produce stems 6 to 12 feet long and by the end of the second season should entirely cover the ground." (*Piper.*)

(See also S. P. I. No. 9227.)

22342 to 22348.

From Peking, Chihli, China. Received through Mr. Frank N. Meyer, agricultural explorer, at the Plant Introduction Garden, Chico, Cal., February 4, 1908.

A collection of seeds, as follows:

22342. FAGARA AILANTHOIDES (S. & Z.) Engl.

From Boshan, Shantung, China. "(No. 778a, Sept. 19, 1907.) A few seeds of this ornamental tree, which is worth planting more extensively. Very handsome when in flower or when loaded with its scarlet capsules." (*Meyer.*)

22343. AMYGDALUS PERSICA L. **Peach.**

From Ningpo, Chehkiang, China. "(No. 827a, July 3, 1907.) Bought at Ningpo for trial to see if new types appear among them." (*Meyer.*)

22344. AMYGDALUS ARMENIACA (L.) Dum. **Apricot.**

From Ningpo, Chehkiang, China. "(No. 828a, July 3, 1907.) A very large apricot, bought in Ningpo, said to come from Shantung." (*Meyer.*)

22345. PRUNUS sp. **Cherry.**

From Peking, Chihli, China. "(No. 829a, May 20, 1907.) A very small fruited cherry, obtainable for a couple of weeks on the market in Peking. Edible, but almost too small for us whites; may be an ornamental shrub. Chinese name *Yue ye mei tāo*, this name, however, may not be right." (*Meyer.*)

22346. RHUS sp.

From mountains near Peking, Chihli, China. "(No. 830a, May 27, 1907.) A shrub, sometimes growing into a small tree; grows among the rocks and on dry places. Fit to cover dry mountain sides in the southwestern regions of the United States so as to prevent the washing down of the soil." (*Meyer.*)

22347. REHMANNIA GLUTINOSA (Gaertn.) Libosch.

From Mingkien, Shansi, China. "(No. 831a, May 15, 1907.) A scrophulariaceous plant growing on old walls and on dry banks. Has rather large buff-purplish flowers. May be improved upon and become a garden plant for the arid regions of the United States." (*Meyer.*)

22348. CENTAUREA sp.

From mountains near Peking, Chihli, China. "(No. 832a, May 27, 1907.) A very large flowered Centaurea of blue-purplish color. Perhaps fit as an ornamental plant in dry regions." (*Meyer.*)

22349. PHRAGMITES VULGARIS LONGIVALVIS (Steud.) W. F. Wight. (PHRAGMITES LONGIVALVIS Steud.)

From Yokohama, Japan. Purchased from the Yokohama Nursery Company. Received March 19, 1908.

"*Phragmites vulgaris longivalvis* (Steud.) differs from the common form, *Phragmites communis* Trin., *P. vulgaris* Lam., *Arundo phragmites* L., *Phragmites phragmites* Karst., in having the lower glume elongated, the panicle thus

22349—Continued.

appearing to have broader spikelets and resembling *Arundo donax*. From the herbarium specimens this form appears to be more robust than *Phragmites vulgaris* as it occurs in Japan, the stem being as thick as one's little finger. Franchet and Savatier place this as a variety of *P. vulgaris*, with the remark that it is scarcely worthy of this recognition. The species is cosmopolitan and somewhat variable, and I think this form is scarcely more than a variety. It is to be noted, however, that the Japanese name for this is *Yoshu-take*, to distinguish it from *Yoshi*, the other form of *P. vulgaris*." (*A. S. Hitchcock.*)

22350 to 22378.

From Peking, Chihli, China. Received through Mr. Frank N. Meyer, agricultural explorer, March 20, 1908.

The following cuttings and seeds:

22350. Diospyros kaki L. f. **Persimmon.**

From Shifengtse Temple, west of Peking, Chihli, China. "(No. 208, Jan. 17, 1908.) A large, flat, seedless persimmon. Apparently a variety of the one sent under Nos. 104 and 105 (S. P. I. Nos. 16912 and 16921). As the trees were growing in a very well sheltered valley this large-fruiting quality may be due to the location. Chinese name *Ta shi tse*." (*Meyer.*)

22351. Amygdalus persica L. **Peach.**

From Shifengtse Temple, west of Peking, Chihli, China. "(No. 211, Jan. 17, 1908.) Said to be a large peach of reddish color. Chinese name *Ta tau*." (*Meyer.*)

22352. Amygdalus persica L. **Peach.**

From Shifengtse Temple, west of Peking, Chihli, China. "(No. 212, Jan. 17, 1908.) Said to be medium sized, very flat, and of reddish color. Chinese name *Pien tau*." (*Meyer.*)

22353. Aesculus chinensis Bunge.

From Tanchetse Temple, west of Peking, Chihli, China. "(No. 213, Jan. 19, 1908.) The Chinese horse-chestnut, a beautiful new shade tree, quite rare here in China. Scions formerly sent under No. 81 (S. P. I. No. 17736). As the tree is more closely related to the Pavias than to the Aesculus it will probably thrive better when grafted upon stock of the first group. Chinese name *So lo shu*." (*Meyer.*)

22354. Aesculus chinensis Bunge.

From Tanchetse Temple, west of Peking, Chihli, China. "(No. 216, Jan. 21, 1908.) The same as No. 213 (S. P. I. No. 22353) but from a different location. The same remarks apply to it. The largest specimens occur in the Tanchetse Temple, southwest of Peking, where the trunk of the biggest one measures 12½ feet in circumference." (*Meyer.*)

22355. Populus alba tomentosa (Carr.) Wesmael.

From Hsiendjetse Temple, west of Peking, Chihli, China. "(No. 217, Jan. 21, 1908.) The large-leaved Chinese poplar as sent before under several numbers. These trees grow remarkably straight and tall. The Chinese prune the lower branches off, until there is often a clear trunk of 40 feet before the first branch is reached. May prove to be a very good street tree. Chinese name *Pai yang shu*." (*Meyer.*)

22356. Syringa sp.

From Changnantse Temple, west of Peking, Chihli, China. "(No. 218, Jan. 21, 1908.) Blue lilac. A very floriferous variety of lilac, with small leaves; very drought resisting. Chinese name *Lang ting hsien shu*." (*Meyer.*)

22350 to 22378—Continued.

22357. SYRINGA sp.

From Changnantse Temple, west of Peking, Chihli, China. "(No. 219, Jan. 21, 1908.) A white-flowering variety of lilac, said to be very fine. Also, like the preceding (S. P. I. No. 22356), very drought resistant. Chinese name *Pai ting hsien shu*." (*Meyer.*)

22358. AMYGDALUS PERSICA L. **Peach.**

From Poliping, west of Peking, Chihli, China. "(No. 221, Jan. 22, 1908.) A rather large peach of whitish color and said to be very fine; realizes high prices in Peking and is far from being easily obtained. The trees grow slowly and do not attain large dimensions, 7 to 8 feet seems to be the maximum height; they seem to suffer much from scales. Chinese name *Mi tau*, meaning honey peach. They grow on terraces in the mountains at 1,000 feet and more altitude." (*Meyer.*)

22359. AMYGDALUS PERSICA L. **Peach.**

From Poliping, west of Peking, Chihli, China. "(No. 222, Jan. 22, 1908.) A peach said to be very large, of red meat, and not so sweet as the preceding number (S. P. I. No. 22358), growing in the same localities and apparently very little attacked by scales. A thrifty grower, though not becoming tall. Chinese name *Hong tau, meaning red peach*." (*Meyer.*)

22360. AMYGDALUS PERSICA L. **Peach.**

From Poliping, west of Peking, Chihli, China. "(No. 223, Jan. 23, 1908.) A peach said to be almost like No. 221 (S. P. I. No. 22358), but of more thrifty growth and bearing much longer leaves, called as such *Ta ye tau*, meaning long-leaved peach. Growing under the same conditions as No. 221 (S. P. I. No. 22358) and very little attacked by scales. The soil in these mountains is reddish decomposed granite and does not seem to be very fertile." (*Meyer.*)

22361. PRUNUS sp. **Cherry.**

From Poliping, west of Peking, Chihli, China. "(No. 228, Jan. 22, 1908.) A tall-growing bush cherry, 10 to 15 feet high, bearing small cherries. Seems to be able to stand trying climatic conditions, such as drought and summer heat. Chinese name *Ying taur*." (*Meyer.*)

22362. DIOSPYROS KAKI L. f. **Persimmon.**

From Poliping, west of Peking, Chihli, China. "(No. 229, Jan. 22, 1908.) A large, flat, seedless persimmon, apparently the same as No. 104 (S. P. I. No. 16912). Chinese name *Ta shi tse*." (*Meyer.*)

22363. POPULUS BALSAMIFERA SUAVEOLENS (Fisch.) Wesm. **Poplar.**

From Shiling, Chihli, China. "(No. 230, Jan. 25, 1908.) A remarkable variety of the small-leaved Chinese poplar; looks like the Lombardy poplar, but makes a more pleasing impression. Loves a sandy, moisture-retaining soil. Chinese name *Tchau tien pai yang shu*, which is probably an erroneous name, as *pai yang* means the *Populus tomentosa*." (*Meyer.*)

22364. ULMUS MACROCARPA Hance. (?) **Elm.**

From Shiling, Chihli, China. "(No. 231, Jan. 25, 1908.) A shrubby elm, often having irregular, corky wings along its branches. Grows on very dry and rocky mountain slopes, growing from a couple of feet up to 20 or 30 feet high. Chinese name *Shan yu shu*. Seems to be very variable in its habitus." (*Meyer.*)

22365. DIOSPYROS KAKI L. f. **Persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 232, Jan. 30, 1908.) A large, very flat persimmon of orange-red color; grows in great orchards in the mountain valleys. These fruits are flatter in shape, and also sweeter in taste, than Nos. 104 and 105 (S. P. I. Nos. 16912 and 16921), but they seem to love a warmer, more sheltered location. They form a very large item in the providing of a livelihood for thousands of

22350 to 22378—Continued.

people. The total amount of money received from around Taidjatsoa village for persimmons last fall amounted to $10,000 (Mexican). Chinese name *Ta mo pan shi tzc.*" (*Meyer.*)

22366. DIOSPYROS KAKI L. f. **Persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 233, Jan. 30, 1908.) A small, flat, seedless persimmon of orange-red color. While the very large variety ranges from 3 to 5 inches in diameter, this one varies between 2 and 3 inches; for this reason not much planted. Chinese name *Shau mo pan shi tzc.* Like the large ones they also have the incision all around." (*Meyer.*)

22367. DIOSPYROS KAKI L. f. **Persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 234, Jan. 30, 1908.) A small-fruited, seedless persimmon, not quite flat, which bears, besides the circular incision, two incisions across, which vary greatly in different fruits. The tree grows to a very much larger size than the ordinary flat-fruited ones. Apparently the same as sent under No. 97 (S. P. I. No. 16910). Chinese name locally for this variety is *Lien hua shi tzc,* meaning lotus flower persimmon." (*Meyer.*)

22368. DIOSPYROS KAKI L. f. **Persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 235, Jan. 30, 1908.) A small-fruited, yellow persimmon with seeds. A slow grower; has whitish bark; is rare. Chinese name *Neu sien shi tzc.*" (*Meyer.*)

22369. DIOSPYROS KAKI L. f. **Persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 236, Jan. 30, 1908.) A small-fruited, oblong, scarlet-red persimmon with seeds. Chinese name *Whoc shi tzc shu.*" (*Meyer.*)

22370. DIOSPYROS KAKI L. f. **Wild persimmon.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 237, Jan. 30, 1908.) A yellow-fruited variety of this tree upon which, in northeastern China, the Chinese graft all their improved varieties. The ordinary variety always has black fruits. Chinese name *Huang yuang tsao.*" (*Meyer.*)

22371. MALUS SYLVESTRIS Mill. **Apple.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 238, Jan. 30, 1908.) A white apple. The trees grow spreading and are long lived. Probably the same as No. 227 (S. P. I. No. 22440), but there is much variation among these Chinese apples. Chinese name *Pai ping kua.*" (*Meyer.*)

22372. MALUS SYLVESTRIS Mill. **Apple.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 239, Jan. 30, 1908.) A medium-sized red apple of sweet taste. The trees grow very spreading and are long lived. Chinese name *Hong teng kua.*" (*Meyer.*)

22373. AMYGDALUS PERSICA L. **Peach.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 243, Jan. 30, 1908.) Said to be a white peach with a red tip and having juicy meat. Chinese name *Pai tau hong tchor.*" (*Meyer.*)

22374. THUYA ORIENTALIS L.

From Peking, Chihli, China. "(No. 251, Feb. 6, 1908.) A wonderful branch variation of the ordinary *Thuya orientalis.* The Chinese call this variation *Fong Huang su,* meaning the rising phœnix tree." (*Meyer.*)

22375. ULMUS PARVIFOLIA Jacq. **Elm.**

From Peking, Chihli, China. "(No. 252, Feb. 6, 1908.) A tall, spreading elm, with many small branches bearing small leaves and flowering in fall. In the winter the bark peels off in curiously formed pieces. I

22350 to 22378—Continued.

have seen only two specimens in China during all my wanderings and these two grow in the grounds of the Temple of Heaven at Peking, from where these scions are taken." (*Meyer.*)

22376. Gleditsia sinensis Lam.

From Lungtsuantse Temple, west of Peking, Chihli, China. "(No. 901a, Jan. 17, 1908.) A Gleditsia bearing heavy, fleshy pods, which are utilized by the Chinese as a substitute for soap; they slice them up and pour boiling water over them and use them to wash fine clothes and also their hair. The pods contain a very biting substance which makes one sneeze when it enters the nostrils, and when it gets in the eyes it is even quite painful; they burn well in the fire; test them for their chemical properties. The tree itself is medium sized and makes a nice, round head; well fit to be used as an ornamental tree in parks and gardens; it is a slow grower. There is great variation among the trees so far as size and shape of pods are concerned. They are apparently in a state of mutation. Chinese name *Tsau jo shu.* Seeds sent formerly from different locations under Nos. 106a and 174a (S. P. I. Nos. 17889 and 18579).

"Immerse the seeds for half a minute in boiling water to insure a uniform germination, as otherwise they may remain dormant for a year or even longer." (*Meyer.*)

22377. Gleditsia sp.

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 902a, Jan. 30, 1908.) A tall, slender-stemmed locust, bearing small pods which are of no use to the people. It seems to be a very rare tree. Chinese name *Hoo li tchoi.* Give the seeds the same treatment as the preceding number (S. P. I. No. 22376)." (*Meyer.*)

22378. Juglans mandshurica Maxim. **Walnut.**

From Tchitaitse Temple, west of Peking, Chihli, China. "(No. 910a, Jan. 16, 1908.) A peculiar kind of a wild walnut, growing here and there in the mountains." (*Meyer.*)

22379 to 22383.

From Canton, Kwangtung, China. Presented by Dr. J. M. Swan, Cooks Hospital. Received March 20, 1908.

22379 to 22381. Glycine hispida (Moench) Maxim. **Soy bean.**

22379. Yellow.

22380. Black.

22381. Green mixed with yellow and a few brown.

22382. Vigna unguiculata (L.) Walp. **Cowpea.**

Brown-Eye.

22383. Phaseolus angularis (Willd.) W. F. Wight. **Adzuki bean.**

Red.

22384 to 22390.

From Buitenzorg, Java. Presented by Dr. M. Treub, director, Botanic Gardens. Received March 20, 1908.

22384. Nephelium lappaceum L.

22385. Lansium domesticum Jack.

22386. Garcinia fusca Pierre.

22387. Garcinia loureiri Pierre.

22388. Garcinia mangostana L.

22389. Garcinia sizygiifolia Pierre.

22390. Garcinia tinctoria DC. (Xanthochymus tinctorius DC.)

22391. VIGNA UNGUICULATA (L.) Walp. Cowpea.

From Manila, P. I. Presented by Mr. W. S. Lyon, through Mr. O. W. Barrett. Received March 23, 1908.

Probably *Iron*. "Seed procured from the New Guinea-Venezuela variety. Early, prolific, and vigorous. Harvested ripe pods 48 days from planting." (*Lyon*.)

22392. ARGYREIA NERVOSA (Burm.) Boj.

From Manila, P. I. Presented by Mr. W. S. Lyon, through Mr. O. W. Barrett. Received March 23, 1908.

"Original seed received from Mr. O. W. Barrett, under the name *Ipomoea* sp., from Brazil.

"A perennial growing to a length of 40 to 50 or more meters. Flowers a reddish violet color." (*Lyon*.)

22393. SESBAN GRANDIFLORA (L.) Poir.

From Rockhampton, Queensland, Australia. Presented by Mr. J. H. Maiden, director of the Botanic Gardens, Sydney, New South Wales. Received March 16, 1908.

(For description see S. P. I. Nos. 3786 and 5209.)

22394 to 22404. RAPHANUS SATIVUS L. Radish.

From Yokohama, Japan. Purchased from the Yokohama Nursery Company. Received March 16, 1908.

The following seeds with Japanese varietal names:

22394. *Kameido.*

22395. *Hosane.*

22396. *O-maru.*

22397. *Nerima.*

22398. *Ninengo.*

22399. *Sakurajima.*

22400. *Seigoin.*

22401. *Natsu-daikon* or *Summer* radish.

22402. *Owari-Miyajiu.*

22403. *Kairyo-Miyajiu.*

22404. *Toki-maki.*

22405. SOLANUM sp.

From Nice, France. Presented by Dr. A. Robertson-Proschowsky, through Mr. O. W. Barrett. Received March 6, 1908.

"A very ornamental Solanum, a small tree covered with thousands of red fruits (possibly from Peru)." (*Proschowsky*.)

22406 to 22410.

From Hongkong, China. Presented by Mr. S. T. Dunn, Botanical and Forestry Department. Received March 26, 1908.

22406. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

Yellow.

22407. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

Black.

22408. VIGNA UNGUICULATA (L.) Walp. **Cowpea.**

Brown-Eye.

22409. PHASEOLUS RADIATUS L. **Mung bean.**

22410. PHASEOLUS ANGULARIS (Willd.) W. F. Wight. **Adzuki bean.**

Red.

22411 to 22415. Glycine hispida (Moench) Maxim. **Soy bean.**

From Naples, Italy. Purchased from Dammann & Co. Received March 25, 1908.

22411. *Samarow.*

22412. Black. "Similar to *Cloud.*" (*Nielsen.*)

22413. Brown.

22414. Yellow. "Similar to *Acme.*" (*Nielsen.*)

22415. Giant yellow.

22416 to 22418. Medicago spp.

From Berlin, Germany. Purchased from A. Metz & Co. Received March 24, 1908.

22416. Medicago sativa L. **Alfalfa.**

Piedmont.

22417. Medicago sativa L. **Alfalfa.**

Provence.

22418. Medicago sativa varia (Mart.) Urb. **Alfalfa.**

Sand lucern.

22419. Perilla frutescens (L.) Britton.

From Ichang, Hupeh, China. Secured by Mr. E. H. Wilson, of the Arnold Arboretum, Jamaica Plain, Mass., in cooperation with this Department. Received March 21, 1908.

"(No. 793, Jan. 23, 1908.) Herb, 3 to 4 feet, cultivated in the mountains in the immediate neighborhood of Ichang, at altitude from 1,000 to 3,500 feet. From the seeds is expressed a sweet, culinary oil, much esteemed by the Chinese locally. The colloquial name is *Tzu ma.*" (*Wilson.*)

22420. Chaetochloa italica (L.) Scribn. **Millet.**

From Mitchell, S. Dak. Purchased from the Dakota Improved Seed Company. Received March 23, 1908.

Kursk. "To be used in classification and varietal tests." (*Vinall.*)

22428. Glycine soja Sieb. & Zucc.

Grown at Arlington Farm, Virginia, season of 1907, under C. V. P. No. 0474. Received March, 1908.

"Original seed presented by the Botanic Gardens, Tokyo, Japan. A near relative to the soy bean, but a spreading or decumbent plant, abundantly provided with large root nodules. Has considerable promise as a cover or green manure crop." (*Piper.*)

22429. Ruscus aculeatus L. **Butcher's broom.**

From Vomero, Naples, Italy. Presented by Dr. C. Sprenger. Received March 28, 1908.

"An erect (liliaceous) shrub, with minute, bractlike leaves and branches (phyllodia) simulating leathery, persistent, leaflike bodies. The fruits are red berries, one-half inch in diameter; the flowers are small." (*Bailey.*)

22430. CHRYSOPHYLLUM MAGLISMONTANA Sond. **Stem-vrugte.**

From Pretoria, Transvaal. Presented by Prof. J. Burtt Davy, agrostologist and botanist, Transvaal Department of Agriculture. Received March 27, 1908.

"A handsome evergreen shrub or small tree. Requires a warm, temperate climate, but will stand light frost." (*Davy.*)

22431. KYLLINGA BREVIFOLIA Rottb. **Sedge.**

Grown in the Department greenhouse, Washington, D. C., under C. V. P. No. 0569, season 1907–8; numbered, for convenience in distributing, March 28, 1908.

"Original sod received from Mr. A. G. Sullivan, Birmingham, Ala., November 5, 1907. It is a fine-leaved sedge of a very rich green color and a decided stoloniferous habit. It is claimed to be quite aggressive in the lawn of Mr. Sullivan and to take kindly to repeated mowings. To be developed as a lawn plant for the South." (*Vinall.*)

22432 to 22459.

From Peking, Chihli, China. Received through Mr. Frank N. Meyer, agricultural explorer, at the Plant Introduction Garden, Chico, Cal., March 16, 1908.

A collection of cuttings and seeds, as follows:

22432. PYRUS CHINENSIS Lindl. **Pear.**

From Shifengtse Temple, west of Peking, Chihli, China. "(No. 209, Jan. 17, 1908.) A large variety of the so-called Peking pear; round like an apple, of very pale yellow color, and of melting flesh. Can be introduced into the Western World as it is. Formerly sent under No. 109 (S. P. I. No. 16916). Chinese name *Ta pai li.*" (*Meyer.*)

22433. PRUNUS sp. **Plum.**

From Shifengtse Temple, west of Peking, Chihli, China. "(No. 210, Jan. 17, 1908.) A large, red plum, said to be early and very good. Chinese name *Ta hong li tse.*" (*Meyer.*)

22434. MALUS sp. **Crab apple.**

From Hsiendjetse Temple, west of Peking, Chihli, China. "(No. 214, Jan. 21, 1908.) A fine flowering crab apple, of shrubby form, bearing masses of rose-colored flowers followed by edible scarlet crab apples. Chinese name *Hai tang kua.*" (*Meyer.*)

22435. MALUS sp. **Crab apple.**

From Hsiendjetse Temple, west of Peking, Chihli, China. "(No. 215, Jan. 21, 1908.) A variety of the preceding, No. 214 (S. P. I. No. 22434); said to be larger, with flowers of white color, followed by very small fruits." (*Meyer.*)

22436. (Undetermined.)

From Changnantse Temple, west of Peking, Chihli, China. "(No. 220, Jan. 21, 1908.) Tree cuttings, probably a Rhus, but as no leaves could be found it may prove to be something different; the wood is very hard and brittle. The tree is said to be the only specimen around Peking, as a priest assured us." (*Meyer.*)

22437. AMYGDALUS ARMENIACA (L.) Dum. **Apricot.**

From Poliping, west of Peking, Chihli, China. "(No. 224, Jan. 22, 1908.) A large apricot, said to be white with a red tip. Chinese name *Hai tschai ta pai sing.*" (*Meyer.*)

22438. PYRUS CHINENSIS Lindl. **Pear.**

From Poliping, west of Peking, Chihli, China. "(No. 225, Jan. 22, 1908.) A very good pear, nonmelting, but very juicy. The Chinese consider this one of their best pears. A good keeper. Color light yellow, of

22432 to 22459—Continued.

regular pear shape with a long peduncle. There are several distinct varieties of this pear and yet all are called *Yar li*. One form sent in 1905 under No. 119 (S. P. I. No. 16924)." (*Meyer.*)

22439. Pyrus chinensis Lindl. **Pear.**

From Poliping, west of Peking, Chihli, China. "(No. 226, Jan. 22, 1908.) A hard-meated round pear of yellow color with a red cheek, looks like an apple; an extraordinary keeper, even when treated roughly. May be of use as a cooking pear. Chinese name *Hong hsau li.*" (*Meyer.*)

22440. Malus sylvestris Mill. **Apple.**

From Poliping, west of Peking, Chihli, China. "(No. 227, Jan. 22, 1908.) A small white apple, called *Pai ping kus*, used in sweetmeats and preserves." (*Meyer.*)

22441. Prunus sp. **Plum.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 240, Jan. 30, 1908.) A large yellow plum, very bushy but growing very vigorously. Said to be good. Chinese name *Huang li tse.*" (*Meyer.*)

22442. Pyrus chinensis Lindl. **Pear.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 241, Jan. 30, 1908.) A large variety of the so-called *Yar li*. Sent also under Nos. 119 and 225 (S. P. I. Nos. 16924 and 22438). Chinese name of this variety *Ta yar li.*" (*Meyer.*)

22443. Pyrus chinensis Lindl. **Pear.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 242, Jan. 30, 1908.) A round apple-shaped pear of red color, hard meated but sweet; a good shipper; fit perhaps as a cooking pear. Chinese name *Hong bo li.*" (*Meyer.*)

22444. Amygdalus armeniaca (L.) Dum. **Apricot.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 244, Jan. 30, 1908.) An apricot which is said to be half red and half yellow. Chinese name *Hai tang hong sing.*" (*Meyer.*)

22445. Amygdalus armeniaca (L.) Dum. **Apricot.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 245, Jan. 30, 1908.) A large yellow apricot with edible sweet kernel. Chinese name *Ta huang sing.*" (*Meyer.*)

22446. Amygdalus armeniaca (L.) Dum. **Apricot.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 246, Jan. 30, 1908.) A small red apricot of sweet taste and with edible sweet kernel. Chinese name *Shau hong sing.*" (*Meyer.*)

22447. Populus balsamifera suaveolens (Fisch.) Wesm. **Poplar.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 247, Jan. 30, 1908.) An extraordinary slender form of *Populus suaveolens*. A beautiful tree when planted in a row along a water course with the western sky as background. Chinese name *Pau yang shu*. For other remarks see No. 230 (S. P. I. No. 22363)." (*Meyer.*)

22448. Morus alba L. **Mulberry.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 248, Jan. 30, 1908.) A wild form of the mulberry growing into medium-sized, well-formed trees. Apparently a distinct form. Chinese name *Sang shu.*" (*Meyer.*)

22449. Rosa sp. **Rose.**

From Pautingfu, Chihli, China. "(No. 249, Jan. 30, 1908.) Said to be a beautiful, yellow rambler rose, flowering with an abundance of flowers. Obtained from the garden of the American Presbyterian Mission in Pautingfu, who procured it from a Chinese nurseryman." (*Meyer.*)

22432 to 22459—Continued.

22450. SALIX sp. **Willow.**

From near Pautingfu, Chihli, China. "(No. 250, Jan. 30, 1908.) The ordinary willow which grows excellently everywhere on the dry lands in North China. Needs no water supply beyond a scanty summer rainfall." (*Meyer.*)

22451. MORUS ALBA L. **Mulberry.**

From Peking, Chihli, China. "(No. 253, Feb. 10, 1908.) A tall-growing mulberry, bearing entire, oblong leaves. Grows here and there in Peking in gardens and is a good shade tree." (*Meyer.*)

22452. ROSA XANTHINA Lindl. **Rose.**

From Peking, Chihli, China. "(No. 254, Feb. 10, 1908.) A semidouble yellow rose of very thrifty growth. Nonfragrant, but extraordinarily floriferous. Blooms but once a year. See Nos. 67 and 68 (S. P. I. No. 17469) for other remarks." (*Meyer.*)

22453. ROSA RUGOSA Thunb. **Rose.**

From Peking, Chihli, China. "(No. 255, Feb. 10, 1908.) A double so-called Japanese rose, although it is a native of North China. This variety grows only 2 to 4 feet high and bears large magenta-colored flowers of very sweet odor. The petals of these roses are very much esteemed by the Chinese for flavoring their tea, perfuming their rooms, and to use in toilet waters. They are grown in large quantities for these purposes." (*Meyer.*)

22454. CELTIS sp. **Hackberry.**

From Hsiling, Chihli, China. "(No. 904a, Jan. 25, 1908.) A small-leaved Celtis, growing into a small-sized ornamental tree. Can stand lots of drought. The galls of this tree are, like those of the following number (S. P. I. No. 22455), eaten by the Chinese after the insect has been taken out. They are said to taste like cucumbers." (*Meyer.*)

22455. CELTIS sp. **Hackberry.**

From near Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 905a, Jan. 31, 1908.) A tall Celtis, of use as a shade tree. Called in Chinese *Shan huang kwa shu*, which means wild cucumber tree, on account of the peculiar galls which infest this tree, which are eaten and taste like wild cucumbers, so they say." (*Meyer.*)

22456. PINUS BUNGEANA Zucc. **Pine.**

From Changnantse Temple, west of Peking, Chihli, China. "(No. 906a, Jan. 21, 1908.) The most glorious of all pines. See notes to Nos. 137a and 139a (S. P. I. No. 17912). Chinese name *Pai huorr sung shu.*" (*Meyer.*)

22457. XANTHOCERAS SORBIFOLIA Bunge.

From Changnantse Temple, west of Peking, Chihli, China. "(No. 907a, Jan. 23, 1908.) This beautiful flowering shrub, which sometimes grows into a small tree, is often found in the temple courts and is well worth planting. Seeds formerly sent under No. 11a (S. P. I. No. 18264). Chinese name *Mu kua hua.*" (*Meyer.*)

22458. CERCIS CHINENSIS Bunge.

From Changnantse Temple, west of Peking, Chihli, China. "(No. 908a, Jan. 23, 1908.) The Chinese red-bud, a very ornamental bush when in flower; blooms before the leaves are out. Leaves large, glossy green, and more or less heart shaped. Grows to be 10 to 12 feet high and stands droughts very well. Chinese name *Tze ching.*" (*Meyer.*)

22459. BRASSICA OLERACEA L. **Cabbage.**

From Taidjatsoa, west of Pautingfu, Chihli, China. "(No. 909a, Jan. 30, 1908.) A very solid, oblong cabbage with the leaves overlapping

22432 to 22459—Continued.

each other, a rare thing with Chinese cabbage. Very much esteemed locally. Needs a rich, well-irrigated soil. Sow in June, transplant in early September. 2 feet apart in each direction, take up after the first frost and store in cool, frostproof pit." (*Meyer.*)

22460 and 22461. CUPRESSUS spp. **Cedar.**

From Paris, France. Purchased from Vilmorin-Andrieux & Co. Received March 27, 1908.

22460. CUPRESSUS BENTHAMI KNIGHTIANA (Perry) Mast.

22461. CUPRESSUS BENTHAMI LINDLEYI (Klotzsch) Mast.

22463 and 22464. STIZOLOBIUM spp.

From Saharunpur, Northwest Province, British India. Presented by Mr. A. C. Hartless, superintendent, Government Botanic Gardens. Received March 30, 1908.

22463. STIZOLOBIUM NIVEUM (Roxb.) Kuntze.

(For description see No. 19181.)

22464. STIZOLOBIUM CAPITATUM (Roxb.) Kuntze.

22465. MEDICAGO SATIVA L. **Alfalfa.**

From Guaranda, Ecuador. Presented by Father Luis Sodiro, through Mr. C. J. Brand. Received March, 1908.

Morada or *Guaranda.* "This alfalfa is extensively grown in the Province of Bolivar at altitudes of 6,000 to 9,000 feet. Methods of cultivation, etc., are described in Bulletin No. 118, Bureau of Plant Industry." (*Brand.*)

22466. MEDICAGO SATIVA L. **Alfalfa.**

From Lima, Peru. Presented by Prof. George Vanderghen, director of the Escuela Nacional de Agricultura, through Mr. C. J. Brand. Received March, 1908.

Monsefu. "This alfalfa is quite commonly cultivated in Peru; yields more cuttings and is more hairy, woody, and hollow stemmed than ordinary or Chilean alfalfa." (*Brand.*)

22467. MEDICAGO SATIVA L. **Alfalfa.**

From Oberschüpf in Baden, Germany. Secured from Mr. Ludwig Keller, landwirth, through Mr. C. J. Brand. Received March, 1908.

Alt Deutsche Frankische. "(P. L. H. No. 3321.) This alfalfa has been grown for some years in south Germany on soils rich in shells and jurassic lime. It is grown especially in the vineyard regions, where a specialty is made of seed production. For this purpose fields having a southern exposure are given preference. When grown between the rows of grapes it gives its highest yields. Practically nothing is known of injury from dodder where this strain is grown, which has led to a belief among some growers in Baden that it is immune to dodder. This, however, is not the case. Sections where this *Old German Frankonian* lucern is grown are little adapted, on account of climatic conditions, to seed production, and it is said that this strain is the only one which has given satisfactory results. The seed is generally sown broadcast under barley. After the first year many growers throw the lucern into rows by hoeing. This enables the lower heads on the plants to mature their seed, and also tends to give a more uniformly ripe product.

"The first cutting is made when the lucern is about half grown (60 centimeters high), in order that the second crop may have time to mature its seed by September. Hulling machinery is uncommon in south Germany, so that pods are thrashed from the straw and then stored in the granary until winter. This method permits a certain amount of after-ripening and also in a measure

22467—Continued.

protects the seed from rodents. Thrashing and screening are done in winter, when the seed is finally made ready for market and sold. Lucern seed grown in this way can not, of course, be sold at the same price as ordinary French, Italian, and *Provence* seed.

"*Alt Deutsche Frankische* lucern is said to be hardier than the ordinary kinds and, on this account, to give greater yields. Fields of it are also said to endure longer than other kinds. While *Provence* lasts from six to eight years, *Old German Frankonian* gives good yields from ten to fifteen years. My correspondent states that the average yield is about 200 pounds per 120 square yards (2 zentner pro ar). The grower from whom this seed was secured has a field 25 years old whose stand is so good that it is still profitable. He states that when the *Provence* alfalfa becomes yellow and loses its lower leaves, which occurs both from drought and excessive moisture, *Frankonian* remains fresh and grows up again immediately after harvesting." (*Brand.*)

22468 to 22486. Corylus avellana L. **Filbert.**

From Nevada City, Cal. Purchased from Mrs. Felix Gillet, Barren Hill Nurseries. Received at the Plant Introduction Garden, Chico, Cal., March 18, 1908.

The following plants, with descriptions by Mrs. Gillet:

22468. *Du Chilly Cobnut.*

Large and long, fine.

22469. *Col. Filbert.*

22470. *Brunswick.*

22471. *Bysance.*

A good grafting stock.

22472. *D'Alger.*

22473. *Geante des Halles.*

22474. *Noce Lunghe.* (Istria, 1901, Dept.)

Finest of all.

22475. *Nottingham.*

22476. *Aveline Grosse Ronde.* (Belgium, 1898, Dept.)

22477. *Emperor.* (Belgium, 1898, Dept.)

22478. *Kentish Cob.*

Long, large.

22479. *Belgium*, 1898, Dept.

22480. *Montebello.* (Sicily, 1905, Dept.)

22481. *White Aveline.*

Thin shell, white pellicle.

22482. *Red Aveline.*

Thin shell, red pellicle.

22483. *Purple-Leafed Aveline.*

Very ornamental.

22484. *Grosse Blanche of England.*

Similar to Barcelona.

22485. *Daviana.*

Medium large, very pretty.

22486. *Barcelona.*

Large, round.

22487. Bambos arundinacea Retz. **Bamboo.**

From Saint Symphorien, Belgium. Presented by Mr. Jean Houzeau de Lehaie. Received March 30, 1908.

(For description see No. 21317.)

22488. Cicer arietinum L. **Chick-pea.**

From Mexico City, Mexico. Purchased from Prof. Felix Foex, National School of Agriculture. Received April 1, 1908.

(For description see Nos. 10974 and 11634.)

22489 to 22492.

From Guelph, Ontario, Canada. Presented by Prof. C. A. Zavitz, Agricultural College, through Mr. N. H. Vinall. Received April 1, 1908.

22489. Chaetochloa italica (L.) Scribn. **Millet.**

California.

22490. Panicum miliaceum L. **Proso millet.**

Red French.

22491. Chaetochloa italica (L.) Scribn. **Millet.**

Holy Terror Gold Mine.

22492. Panicum miliaceum L. **Proso millet.**

Japanese Panicle.

"The above are to be used in classification work and varietal tests." (*Vinall.*)

22496 and 22497.

From Lahore, Punjab, British India. Presented by Mr. W. R. Mustoe, superintendent, Government Historical Gardens. Received March 16, 1908.

22496. Beaumontia grandiflora (Roxb.) Wall.

"A climbing, woody vine. Leaves opposite, short petioled, oblong, 6 to 8 inches long, 2 to 5 inches wide, entire. Flowers greenish yellow, in axillary cymes. Corolla bell shaped, about 5 inches across, five lobed, margin wavy. * * * Seed takes nearly one year to ripen." (*Roxburgh.*)

"Nomen bengalense: Dhootura Luta." (*Wall.*)

22497. Bombax malabaricum DC.

"One of the largest of the Indian trees, often 100 feet high. Leaves alternate, long petioled, digitate. Leaflets, 5 to 7, lanceolate, 6 to 12 inches long, entire, smooth on both sides. Covered with large red flowers early in spring, before the leaves appear.

"*Salmuli*, the Sanscrit name: Beng. *Simul;* Teling. *Boorgha.*" (*Roxburgh, Flora Indica*, vol. 3, p. 167.)

22498 to 22502.

From Hangchow, Chehkiang, China. Presented by Dr. D. Duncan Main, through Mr. J. M. W. Farnham, Shanghai, China. Received March 26, 1908.

22498 to 22501. Glycine hispida (Moench) Maxim. **Soy bean.**

22498. Yellow. Similar to No. 18619.

22499. Yellow.

22500. Green. Similar to No. 17857.

22501. Black.

22502. Pisum arvense L. **Field pea.**

Varietal descriptions of the above were made by Mr. H. T. Nielsen.

22503 to 22510.

From Yokohama, Japan. Purchased from L. Boehmer & Co. Received March 31, 1908.

The following seeds with Japanese names quoted; varietal descriptions by Mr. H. T. Nielsen:

22503 to 22507. GLYCINE HISPIDA (Moench) Maxim. **Soy bean.**

22503. "*Teppo Mame.*"

Yellow, similar in appearance to *Amherst*, No. 17275.

22504. "*Kaze Mame.*"

Green.

22505. "*Gogwatsu Mame.*"

Yellow, similar to *Haberlandt*, No. 17271.

22506. "*Maru Mame.*"

Yellow.

22507. "*Vieuri Lei.*"

Green, similar to *Yosho*, No. 17262.

22508 and 22509. PHASEOLUS ANGULARIS (Willd.) W. F. Wight. **Adzuki bean.**

22508. Red.

22509. "*Shiro.*"

Yellow.

22510. PHASEOLUS RADIATUS L. **Mung bean.**

"*Runda Mame.*"

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O

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 138.

B. T. GALLOWAY, *Chief of Bureau.*

THE PRODUCTION OF CIGAR-WRAPPER TOBACCO UNDER SHADE IN THE CONNECTICUT VALLEY.

BY

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EXPERT, TOBACCO INVESTIGATIONS.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., September 15, 1908.

SIR: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 138 of the series of this Bureau, a manuscript entitled "The Production of Cigar-Wrapper Tobacco under Shade in the Connecticut Valley," by Mr. J. B. Stewart, of the Tobacco Investigations of this Bureau.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE PRODUCTION OF CIGAR-WRAPPER TOBACCO UNDER SHADE IN THE CONNECTICUT VALLEY.

DEVELOPMENT OF THE PRODUCTION OF TOBACCO UNDER SHADE.

The method of producing tobacco under shade originated in Florida about 1896. The adoption of artificial shade was slow, and much labor and expense was incurred in experiments. In a few years, however, the tobacco produced by this method began to take its place in the trade among the higher class of goods and a demand was created for it.

It was at this time that the officials of the Connecticut Agricultural Experiment Station conferred with the representatives of the Bureau of Soils of the United States Department of Agriculture as to the advisability of conducting an experiment with the object of improving the wrapper tobacco in the Connecticut Valley by the adoption of the shade method. As a result of the agreement reached, a joint experiment was conducted in 1900, and one-third of an acre of tobacco from Florida Sumatra seed was produced under shade.

This tobacco was fermented, assorted, and packed, and when offered for sale brought 72 cents a pound. The judges who examined the tobacco, as well as the manufacturers who used it, pronounced it equal, if not superior, to the tobacco imported from the island of Sumatra. No accurate account of the expense of producing this tobacco was kept, and it could not be determined whether at the price mentioned the industry would be profitable to the growers, the object of the experiment being solely to determine whether a marketable tobacco with merit could be produced in Connecticut under shade.

At this stage of the development of the industry the cooperative agreement referred to was discontinued, the State agricultural experiment station and the Bureau of Soils continuing to work along their own lines.

In 1901 about 41 acres of tobacco were produced under shade, the Bureau of Soils furnishing experienced men to instruct the farmers in cultivating, harvesting, and shed-curing the crop, and to take

charge of the fermenting, grading, and packing of the raw product. In order to get this tobacco (about 300 bales) on the market and to secure as widespread a distribution of it as possible among the trade, it was deemed advisable to sell the entire lot by auction. Accordingly, on May 2, 1902, in the Foot Guards Hall, at Hartford, Conn., the tobacco was sold, bale by bale, to the highest bidder. The results were very satisfactory. Some of the bales sold for as much as $2.65 a pound, and one crop of 5 acres averaged for all grades $1.65 a pound, paying the grower $1,000 an acre above all expenses.

Time was not given for the purchasers of this tobacco to report on its merits. The result of the sale was accepted as bona fide evidence of the success of the new industry. The newspapers took up the cry that the salvation of the Connecticut farmer was at hand. There were to be no more hard times. Raising tobacco in Connecticut under shade was a surer road to riches than digging the yellow metal from the richest mines in the Rocky Mountains. Consequently, stock companies for growing tobacco were formed, and almost every farmer who could borrow a few thousand dollars (and borrowing was easy in the sight of such prosperity) grew shade tobacco. Men who had never been attracted by the tobacco industry now sought to purchase farms on which to produce tobacco by this new method, and seed was purchased indiscriminately in Florida at the very high price of $2 an ounce.

The shade-tobacco area spread from 41 acres in 1901 to more than 700 acres in 1902, an enormous growth for a new industry. The season of 1902 proved to be cold and wet. Many of the growers had poor varieties, and more of them did not know enough of the methods in use to enable them to produce a good quality of tobacco. The result was that almost all who had undertaken this new method of producing tobacco found themselves without money and with no market for their goods. Many of the companies and some of the farmers went into bankruptcy and sold their shade tobacco at a loss of from 75 to 90 per cent. The remainder pulled through badly crippled and, thinking that the poor quality of their tobacco was entirely due to an unfavorable season, tried to recuperate by growing shade tobacco another year. The results were, perhaps, even more unfavorable than the previous year, the industry being counted a failure and the cause of heavy financial losses.

In the year 1903 the attention of the Bureau of Plant Industry was called to the failure of shade tobacco in Connecticut, and as the Department of Agriculture had had much to do in promoting the industry it was thought necessary to do everything possible to determine the cause of the failure and apply the remedy.

Knowing the nature of plants and that when seed is transported from a warm climate to a colder one the progeny is almost sure to break up into many varieties, some desirable and some undesirable, a breaking up in type was anticipated. This was found to be the case when a plant breeder from the Bureau of Plant Industry began to make a study of the types of tobacco for uniformity. In one field of 46 acres, 29 distinctly different varieties were found and isolated.[a] Experiments with these varieties were conducted during the seasons of 1904 and 1905 to prove their merit and prepotency. Every variety came true to type, and of the 29 only 2 were found to possess any merit. This suggested a solution to the problem, which has been worked out during the last four years and has been the means of establishing upon a sound and profitable basis the shade-tobacco industry of Connecticut, as will be shown in this publication by the records of demonstration tests on a commercial basis.

CULTURE.

ERECTING THE TENT.

Too much stress can not be laid upon making the tent frame strong in every way, so that there will be as little "give" to it as possible. The outside posts should be well guyed, so that the wires will remain taut when stretched. Much trouble is often caused by the main wires, to which the cloth is sewed, becoming so loose that the pull of the cloth in the wind can move them up and down. This gives the cloth a chance to jerk and break the cord which holds it to the wire, causing a rip, which is difficult to repair.

The most economical distance to set the posts is 24 feet apart each way. To set them farther apart is not safe, because the strain upon the cloth in a high wind involves the danger of loosening the covering at a critical time.

In preparing to erect a tent the first essential is to lay off the land and place a small stake where each post is to be located. To do this start at one corner and lay off a square and set a side and end row of stakes across the field at right angles to each other, sighting them in line and measuring the distance to put them apart in the row. When this is done the rest of the field can be best laid out by the use of a triangle the sides of which are the desired length. Put one leg of the triangle against the end row of stakes and the other leg against the side row and place the new stake in the corner of the triangle. Repeat this until all of the places for posts are marked.

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[a] See Bulletin No. 91 of the Bureau of Plant Industry, entitled, "Varieties of Tobacco Distributed in 1905-6, with Cultural Directions."

The digging of the holes is a simple operation and consists of removing a small portion of the topsoil with a shovel and then deepening the hole to the desired depth, which should not be less than 3 feet, by the use of a common post-hole digger. The posts should be cut at least 11½ feet long and set 3 feet in the ground, this making the tent 8½ feet high. In lining up the posts the tops should be sighted and leveled by lowering or raising a post where necessary, and the rows should be kept straight.

To guy an outside post, a timber not less than 4 feet long and 6 inches in diameter, to which is attached a No. 9 wire, should be sunk in the soil to a depth of 3 feet not less than 6 feet from the base of the post, and the other end of the wire made fast to the top of the post.

This done, the next thing is to stretch the wire. First, run the main No. 6 wires to which the cloth is to be sewed. Make one end fast to the top of an outside end post and stretch the wire taut by the use of a block and pulleys or some other powerful means of purchase and fasten it to the top of the post at the other end of the field. This wire should be fastened firmly to the top of each post in the row.

After all the main, or No. 6, wires have been put on and fastened, cross wires should be run on top of these. At the top of the cross rows of posts use No. 9 wire, and at intervals of 4 feet between the posts stretch a No. 12 wire, fastening it to the outside wire on the sides. At the crossing of two wires, they should be fastened by twisting about them a short piece of small wire. No. 16 wire is a convenient size for this purpose. At the bottom of the outside posts run a No. 9 wire for the purpose of fastening the bottom of the side-wall cloth. The frame is now complete and ready for the cloth. (See Pl. I, fig. 1.)

The cloth used for tents comes from the mills sewed into strips 24 feet wide and usually about 60 yards long. This cloth is run on the wires by threading it under one cross wire and over the next one, and where the ends of the strips meet they are sewed together. The edge of the cloth is now wound around the wire carefully and made fast by sewing with strong twine. This operation is repeated until the field is covered and the tent complete. (See Pl. I, fig. 2.)

PRODUCING THE SEEDLINGS.

Nearly every tobacco grower has his own methods of producing seedlings. In the essential points they vary but little from those of his neighbors, but the details vary considerably. It is well to mention here that if a grower is successful in producing plants by the method he now uses he had better make no change. The methods

FIG. 1.—FRAME OF TENT FOR GROWING TOBACCO UNDER SHADE.

FIG. 2.—TENT FOR GROWING TOBACCO UNDER SHADE.

recorded here are the results of several years of study among the tobacco growers of the Connecticut Valley, as well as of the writer's own practical experience.

As tobacco plants have to be grown in the early spring when the weather is cold and many raw north and west winds prevail, a site should be selected on a southern slope or the winds cut off by a hedge or a high, tight board fence. The next operation is to prepare the beds. This should be partly done in the fall by putting on organic fertilizer, such as stable manure and cotton-seed meal, and thoroughly spading it in. In the spring, as soon as the frost is out of the soil (and this can be hastened by putting a glass covering on the frames), the soil should be thoroughly spaded up and raked over and a small quantity of commercial fertilizer should be applied and raked in. The bed is now raked, leveled, and steam sterilized, when it is ready for the seed.

A great many growers sprout their seed before sowing, but in the writer's experience more healthy plants are produced in less time by sowing the seed dry. If the seed has been well cleaned and blown, about a tablespoonful to 200 square feet of seed bed is sufficient to produce a good stand of plants.

In sowing the seed never mix it with any organic substance, such as corn meal or cotton-seed meal, but use apple-tree punk and sifted coal ashes or land plaster in the following proportions: To five cups of punk add two of ashes and one tablespoonful of seed. Mix thoroughly and sow. After sowing, rake in lightly with an iron rake and press the soil firmly down with a plank. Now wet the bed thoroughly by sprinkling water on it and put on the covering, which may consist of either glass or cloth. The covering should be held about 6 inches above the soil by means of a tight frame made of inch boards placed around the bed.

The seed bed now needs much care, and if the sun is hot the covering should be raised to let in fresh air. Water should be used freely and the top of the soil kept damp until the plants are about an inch high, when water should be used more sparingly and air more frequently given.

It takes from forty to sixty days for the plants to grow large enough to be transplanted to the field. A plant should not be pulled for transplanting until it is at least 4 inches long at the stem and the stalk is almost as large in circumference as a common lead pencil. Some plants in a bed will always grow faster than others, and the large ones should always be taken out first—very carefully, so as not to injure the smaller ones, which grow to make the next pulling.

To pull the plants, first wet the bed thoroughly, so that the plant roots will pull up easily, and then pull the plants by taking hold of the

leaves, not the stem. In this way there is no danger of injuring the bud. The plants when pulled should be placed in shallow boxes, standing, roots down. In this way they can easily be carted to the field ready for transplanting.

TRANSPLANTING THE SEEDLINGS.

The transplanting of the plants is a hard ordeal for them, even at best. However, if care is taken to prepare the land thoroughly and the plants are set well in water and the weather is favorable, there will be a very small percentage of loss from dying. The cutworms and wireworms will of course destroy a few, in some seasons more than in others.

For the wireworms there is no remedy except to kill the worm when found either in the plant or about its roots. For protection against the cutworm, poison can be employed on and near the plants. Paris green and wheat middlings should be thoroughly mixed at the rate of a pound of Paris green to 140 pounds of middlings. If the mixture is stronger than this there is danger of burning the plants, and in the proportion mentioned there is enough of the poison to kill the worms. By the use of a tin can punched full of holes and fastened to a stick about 2 feet long, this mixture can be dusted over and near the plants. A jerk on the stick, shaking the can up and down, will force enough of the poison through the holes for one plant.

The plants, with the exception of the post rows, are set out with a machine called a transplanter. (See Pl. II, fig. 1.) This machine is drawn by a team which is trained to walk very slowly. The machine consists of a barrel to carry the water set on a truck, with a single wheel ahead, which acts as a roller. Behind the truck comes a plow, which opens a furrow, in which the plants are set. Following come the wings, which draw the soil over the roots of the plants and set them. The barrel of water is so connected by a rubber tube and gearing that it lets out about a cupful of water on the roots of each plant as it is set. This puts the water just where it is needed by the plants, and they thrive much better than when set by hand. A machine, three men, and a team can set from 3 to 4 acres of tobacco in a day.

The land should be thoroughly prepared for the plants by plowing, then by sowing the fertilizer, and afterwards by harrowing and smoothing. The smoothing can be done with either a smoothing harrow, a plank, or a brush, but should never be done with a land roller, as this leaves the land packed down too hard.

The fertilizer should contain the following quantities of plant food to the acre: Nitrogen, 140 pounds; phosphoric acid, 100 pounds; potash,

FIG. 1.—TRANSPLANTER AT WORK IN A TOBACCO FIELD.

FIG. 2.—HORSE HOE AT WORK IN A TOBACCO FIELD.

FIG. 1.—FIELD OF TOBACCO, SHOWING THE FIRST AND SECOND PRIMINGS REMOVED.

FIG. 2.—FIELD OF TOBACCO, SHOWING THE ARRANGEMENT OF LEAVES AFTER PRIMING.

120 pounds. On most soils about 300 pounds of lime in addition is beneficial. The heavier the texture of the soil the smaller is the quantity of potash needed.

The plants should be set in rows 3 feet apart and from 12 to 14 inches in the row. To set them farther apart than this, especially in the row, makes the tobacco grow so large and heavy that its quality is injured, although the quantity may be slightly increased.

Three or four days after the plants have been set out, the field should be looked over carefully and fresh plants set in where any have died or are missing. A perfect stand of plants is an essential requirement for a bountiful crop of tobacco of good quality.

CULTIVATING THE SOIL.

Not more than one week after the plants have been set out the soil between the rows should be cultivated with a horse cultivator and the soil around the plants loosened up with a hand hoe. If this hand hoeing is thoroughly done the operation will not necessarily have to be repeated, and further cultivation by the use of the horse hoe (see Pl. II, fig. 2) will be sufficient for the crop.

The land should be stirred as often as once a week, provided the weather conditions do not prevent it. The cultivation should be continued up to topping time, and afterwards if the tobacco has not gained sufficient size to make it impossible to go between the rows with a team without injuring the leaves.

TOPPING AND SUCKERING THE PLANTS.

As the bud appears and just before the flowers open, it should be taken off. As some of the buds will appear before others it will perhaps be necessary to go over the field several times before all of the plants are topped. After topping, the field may rest until after the first priming is made and then the four top suckers should be broken off. This gives to the second priming a body which greatly improves it. This is all of the suckering that should be done, for the taking off of more suckers or the lower topping of the plants makes the tobacco too heavy and coarse for the purpose for which it is intended.

HARVESTING THE CROP.

The time to harvest shade tobacco is when the leaves are fully developed. There is a slight change in color as the tobacco reaches maturity, but it is not safe to allow the leaves to remain on the stalk until this change of color is noticeable to the inexperienced observer, for then they are likely to be too ripe. The best method to follow, and the one which will err in the right direction, is to make the first priming about ten days after topping and the second about ten days later. (See Pl. III, fig. 1, showing a field with the second priming

removed.) The third priming may be taken off about a week after the second, and the fourth, or top-leaf priming, can follow as soon after the third as time will permit. The tobacco of this top priming is not very valuable and should it not be harvested for two or three weeks after the third priming there will not be any great loss unless there is a freeze.

By priming is meant picking the leaves from the stalk in the field. The first priming consists of taking off three or four of the bottom leaves; the second, from four to six leaves; the third, all but two leaves on top of the plant, and the fourth, the remaining leaves.

The leaves, when taken off, are laid in piles along the row. (See Pl. III, fig. 2.) A primer picks the leaves from two rows and puts his primed leaves on the row to his right. Another man priming the two rows to the right of the first primer puts his primed leaves on the row to his left. In this way, two adjoining rows contain all of the primed leaves from four rows of tobacco. A man takes a basket (see Pl. III, fig. 2) and going between these two rows picks up the primed leaves and carries them to a wagon with a special rack on which they are drawn to the shed or curing barn. Great care should be taken not to jam or press down the leaves in the basket so as to bruise them.

In the barn are laths with string attached on which the leaves are sewn with a needle. (See Pl. IV, fig. 1.) This string is fastened to the laths by means of a saw-cut about one-half inch deep in each end. The string is run through the cut, wound once about the lath, and returned through the cut. This holds the string firm. From 32 to 40 leaves, according to their size, are put on each string, face to face and back to back, and the string is fastened to the other end of the lath. These leaves when hung as described are called a "lath" of tobacco, and these laths are now hung on tier poles in the barn to cure.

CURING.

The curing is an important process, for much can be done to add to the quality of the tobacco at this time and if the weather is damp and rainy much needs to be done to prevent the tobacco from being ruined. Tobacco requires from twenty to thirty days to cure and during this period it needs constant care.

If the barns are properly built the curing is done with a certain degree of accuracy. A model barn for this purpose should not be larger than 100 by 40 feet and 20 feet to the eaves. (See Pl. V, figs. 1 and 2.) The walls of the barn should be made of ship lap siding, so that they can be tightly closed. A horizontal ventilator, 6 inches wide, should be placed every 30 inches on the sides of the barn and hung on hinges so that it can be easily opened and shut. By this arrangement, when the ventilators are open there is a circulation of air through the barn between the layers of tobacco.

FIG. 1.—INTERIOR OF A CURING SHED, SHOWING THE METHOD OF STRINGING TOBACCO.

FIG. 2.—STEAM STERILIZER OF THE SOIL AT WORK.

FIG. 1.—TOBACCO BARN WITH VENTILATORS CLOSED.

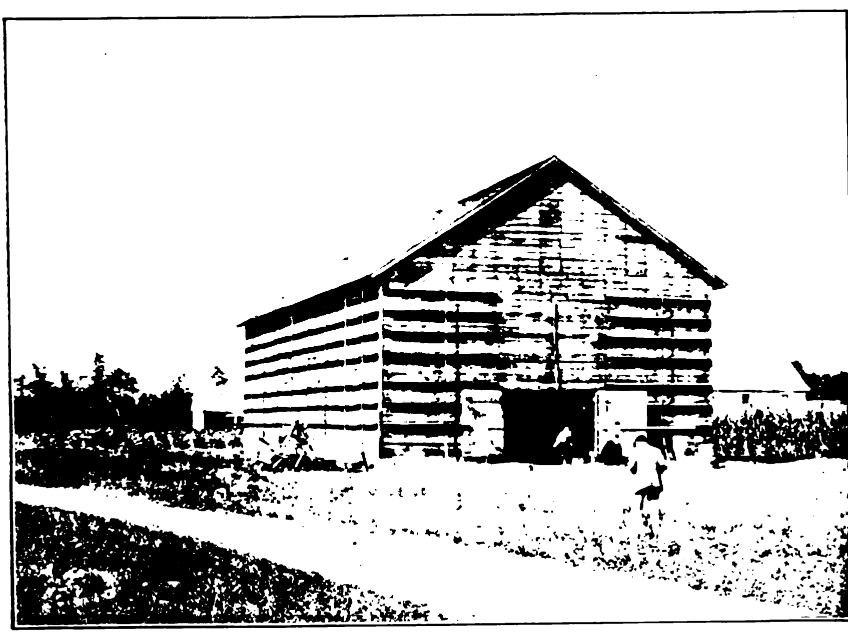

FIG. 2.—TOBACCO BARN WITH VENTILATORS OPEN.

When the barn is filled with fresh tobacco it should be closed tight, and if the weather is cool or damp small charcoal fires should be built in the barn to warm up the tobacco and wilt it down. When the tobacco has wilted and started to yellow, the doors and ventilators should be opened to allow the circulation of air to carry off the moisture. If the curing season is a normal one the doors and ventilators should be opened every morning and closed at night, but if the season is dry the reverse of this action is required, especially when the process of curing the tobacco is nearly completed. If the season is a very damp and rainy one small charcoal fires, placed close together, should be lighted in the barn to dry out the tobacco and prevent it from pole sweating.

After the tobacco is cured the barn should be left closed until there comes a damp, foggy time or a rain, when all of the doors and ventilators should be opened, to allow the tobacco to come "in case," so that it can be taken down. The tobacco is in proper case for taking down when it does not rattle when handled and when at the same time if a number of leaves are squeezed tightly in the hand they will spring partly open again upon releasing the pressure.

TAKING DOWN THE LATHS.

When the tobacco is in case it is in proper condition for taking down. The floor of the barn should be cleared and some old blankets laid down. On these the tobacco is piled without removal from the laths, several laths being taken at a time and the first layer laid so that the laths will be next to the cloth and the tobacco sticking up. The next layer is piled so that the tobacco is next to the tobacco of the other layer and the laths are on top. This process is repeated until the pile is several layers high. When the pile is complete it should be covered well with either blankets or cornstalks, and it can be left with safety for several days before it is stripped if the weather is not too warm. If the weather is warm, there is danger of the tobacco heating and spoiling if left more than four or five days in the pile.

STRIPPING AND BUNDLING THE LEAVES.

The two processes of stripping and bundling go together. A lath of tobacco is taken up and the leaves shoved together at the middle of the string. The string is now severed close to each end of the lath, wound around the leaves at the butt ends, and drawn through the "hand" of leaves so as to fasten it. These "hands" of tobacco, as they are called, are packed in a false box lined with paper, butts out, and the tips of the leaves overlapping in the center. About 30 pounds are packed in each box in this way and then pressed down. Paper is wrapped about the tobacco and tied with strings which were placed at intervals along the box before the paper was put into

it. One side of the box is swung on hinges, so that it can be let down to allow the removal of the tobacco. The tobacco thus packed is called a "bundle" and is ready for market or for the packing house. When tobacco is to be packed by the grower it is not necessary to bundle it, but it may be packed at once into boxes and taken to the warehouse.

The tobacco when packed in bundles may be kept for several weeks or months without much injury if the bundles are piled one layer high and put in a cool, moist place. The sooner the tobacco is put into the ferment after it is taken down, however, the better.

PACKING.

The term "packing" in handling tobacco means the preparing of the raw product for the use of the manufacturers.

The first step in the packing of shade tobacco is to ferment it. This is done by taking the tobacco from the bundle, shaking it out thoroughly, and laying it down in layers in a large pile, called a "bulk," being careful to keep the leaves straight. To build a bulk of tobacco requires some skill and experience. If the bulk is not made properly it is liable to settle sidewise and fall over.

The bulk is built on a platform made of 1-inch boards and raised about 4 inches from the floor, so as to admit a free circulation of air. This platform is made for convenience 12 feet long by 5½ feet wide. In starting to build a bulk a row of hands of tobacco is first laid around the outside edge of the platform, being careful to keep the butts of the hands close together and the leaves straight. This is called the outside tier. The next tier of this layer is laid so as to shingle over the first, lapping well over the tips of the leaves of the first tier. This is repeated until the bottom of the platform is covered. Then another layer is laid on top of this one, and so on until the bulk is from 4 to 6 feet high.

When about half of the tobacco intended for the bulk has been laid down, a tube 4 feet long should be placed so that one end comes to the outside and the other extends to the center of the bulk. This is for the purpose of placing a thermometer in the bulk to keep a record of its temperature.

The temperature of the bulk is an index of how the tobacco is fermenting. The nature of the tobacco, its condition, the temperature of the room in which it is bulked, and the time of the year all have their influence on the degree of rapidity with which the tobacco will heat.

If the tobacco is in high case and is bulked early in the fall in a warm room, it will heat up very rapidly, and the bulk will have to be taken down, the hands of tobacco well shaken out, and the bulk rebuilt, the tobacco which has been on the outside being put on the inside and that which has been on the inside of the bulk on the outside.

On the other hand, if the tobacco is in low case, is not bulked until late in the winter, and is put down in a moderately cool room the tobacco may lay in the bulk for ten days before it begins to heat.

It is evident from these facts that the only guide in fermenting tobacco is the thermometer. The record of the thermometer, coupled with experience, can do much to improve shade tobacco during the fermenting process.

From long-continued experience in fermenting many different kinds of tobacco, the writer has come to the conclusion that the best results can be obtained by placing the tobacco in bulks of about 5,000 pounds, and when the thermometer registers 114° F. tearing down the bulk, shaking out the tobacco, and rebulking. After the bulk has been rebuilt, the temperature should be allowed to come up again to 112° F., or higher if it will, and after this the tobacco is ready for grading.

The fermentation room should be kept during the process of fermentation as nearly as possible at a temperature of 80° F., with about 75 per cent relative humidity. The temperature should be as uniform as possible, because any great change will cause the moisture in the room to settle on the butts of the tobacco and produce mold, which is likely to damage the tobacco. The room should be well ventilated by an air shaft running from near the floor of the room to above the roof of the building.

GRADING.

As shade-grown tobacco has to be graded principally according to color, a well-lighted room is required, and to avoid deep shadows and a varying light the windows should be on the north side of the room. A low ceiling is desirable so as to keep the moisture as low in the room as possible. The room should be kept so moist that the tobacco will not dry up while it is being handled.

When the tobacco is first taken from the bulk, the hands are untied and the leaves shaken out. It is then "sized" so that all of the leaves of the same length come together. This is done by a person taking the leaves and putting them into a box fixed up with partitions so that there is a space for all leaves from 12 to 14 inches long, 14 to 16 inches long, and so on.

After the tobacco has been sorted according to size it is taken to tables, where the leaves are opened and graded, all sound leaves of even color and good texture being classed as wrappers and the rest seconds or binders. The wrappers are further divided into light, medium, dark, and off or mixed, according to their color. The seconds are simply divided according to color into light and dark.

After the tobacco has been graded it is tied with raffia into hands of one-fourth pound each. These hands are now packed into bales of about 150 pounds. The common size for a bale of shade tobacco is

31 by 31 inches and 10 inches thick. The tobacco is baled by packing the hands into a false box. A piece of matting is placed on the bottom of the box and another on the top of the tobacco when the box is filled. The top is now forced down by means of a press and held there until the edges of the two pieces of matting are sewn together, when the bale is made. The bale is now given a number, the weight and grade are marked on it, and it is stored away until sold. Before it can be shipped it must be covered with burlap and crated.

MARKETING.

Tobacco is sold by means of samples, four hands being considered a sample of shade tobacco. A manufacturer or jobber when wishing to purchase shade-grown tobacco looks over a number of samples and picks out those which suit his trade. If the price is satisfactory, a sale is made and the tobacco is shipped.

SUMMARY OF METHODS OF PRODUCING SHADE TOBACCO.

The best methods of producing shade-grown tobacco may be summarized as follows:

(1) Protect the seed bed from north and west winds.

(2) Get a good strain of seed.

(3) Sterilize the seed beds.

(4) Do not sow the seed too thickly.

(5) Give the plants plenty of water.

(6) Plants will be produced under glass earlier than under cloth, but the beds will require more attention.

(7) Do not allow the plants to get too large before transplanting.

(8) Wet the beds thoroughly before pulling the plants for transplanting.

(9) Prepare the land well before transplanting.

(10) Set the plants as close as 14 inches in the row.

(11) Cultivate frequently and thoroughly.

(12) Take out the bud just before the flower opens.

(13) Sucker once, taking off four top suckers.

(14) Do not let the tobacco get too ripe before harvesting.

(15) Make four primings of the crop and keep each priming separate.

(16) Prevent pole-burn by firing, if necessary.

(17) Do not take the tobacco down until all fat stems are cured.

(18) Have the proper amount of moisture in the tobacco when it is taken down.

(19) After it is taken down do not leave the tobacco lying in bundles too long.

(20) Do not allow the temperature to go above 115° F. during fermentation.

(21) Do not ferment too long, so as to dry out the tobacco.

(22) Sort and pack the tobacco without using water to moisten it.

(23) When packed, age the tobacco in bales in a warm, moist room for six weeks.

(24) Figure the cost of production and sell at a profit.

COMMERCIAL VALUE OF SEED SELECTION.

To show the commercial value of seed selection in the production of tobacco, the results of three years' tests are given below. These results were obtained from a row test and are computed to an acre basis for convenience in making comparisons.

In 1905 and 1906 a few selections of the best varieties were grown, but in 1907 a greater number of varieties and selections were grown, many of which were taken from 1904 seed. This was done in order to secure further comparisons for commercial purposes.

In 1907 a commercial test was also made to determine the advisability of advocating the growing of shade tobacco by Connecticut farmers.

Selections having initial numbers from 1 to 10, inclusive, are Sumatra types, while those from 11 up are Cuban types of tobacco.

TABLE I.—*Comparison of selections of varieties of tobacco tested in 1905, 1906, and 1907 reduced to an acre basis.*

Year.	Selection number.	Grade.					Total yield.		Shrinkage.
		Light wrappers.	Medium wrappers.	Dark wrappers.	Seconds.	Off color.	Raw weight.	Packed weight.	
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1905	2-16- 1	269	217	101	341	....	1,081	1,028	53
	3-20- 2	328	111	323	628	....	1,433	1,390	43
	3-15- 1	616	308	215	198	....	1,341	1,337	14
	13- 2- 3	235	273	351	304	....	1,210	1,163	47
	14- 1-11	225	148	144	300	....	882	817	65
	20-15- 1	102	191	191	162	....	710	646	64
1906	3-15- 1	555	128	320	453	....	1,520	1,455	65
	3-20- 2	499	100	404	321	....	1,480	1,312	168
	13- 2- 3	333	240	397	184	....	1,280	1,154	124
	11-14-16- 1	205	282	699	232	....	1,538	1,418	120
	3-16- 8	523	366	576	278	....	1,817	1,737	80
1907	11-32- 3	217	331	337	85	270	1,360	1,240	120
	11-31- 5- 3	448	271	342	92	127	1,380	1,280	100
	11-31- 5- 2	298	270	241	149	262	1,300	1,220	80
	12- 3- 7- 3	158	195	315	340	152	1,208	1,160	48
	13- 2- 3- 1	498	387	268	54	133	1,401	1,340	61
	13- 3- 7- 3	171	217	340	361	171	1,320	1,260	60
	13- 6- 2- 4	374	330	390	68	68	1,280	1,230	50
	14- 2- 7	293	336	165	61	165	1,060	1,020	40
	14- 2- 9	350	214	170	231	175	1,185	1,140	45
	14- 2-10	149	255	411	58	154	1,150	1,120	30
	14- 9- 5- 6	614	150	188	121	150	1,280	1,250	30
	20- 3- 2- 1	93	147	530	141	39	1,005	980	25
	20-16- 1- 2	223	223	267	100	77	905	890	15
	24- 7- 1	189	143	221	170	117	863	840	23
	109- 8- 3- 2	224	288	363	288	417	1,640	1,580	60
	1-15- 1	181	181	372	464	327	1,568	1,525	43
	2-12- 5- 1	815	236	132	38	199	1,520	1,420	100
	2-16- 4- 1	495	292	221	220	232	1,520	1,460	60
	3-12 · 3	153	186	425	462	314	1,620	1,540	80
	3-15- 1	220	61	136	539	504	1,555	1,460	95
	3-16- 8- 6- 1- 2	176	83	237	784	200	1,565	1,480	85
	3-18- 3- 1	285	102	102	364	567	1,517	1,420	97
	3-20- 8- 4- 1	156	119	225	545	446	1,598	1,490	108
	3-20- 8- 4- 3	247	66	297	257	593	1,585	1,460	125
	3-20- 8- 5-15	419	166	236	243	416	1,622	1,480	142

The grading shown in Table I was not as thorough during 1905 and 1906 as it was in 1907. Many of the leaves of the 1905 and 1906 crops which were "off" or streaked in color were put into the light and medium grades. This was a mistake, because the mixture of these off-colored leaves with the others was seriously objected to by the cigar manufacturers, and in this way the commercial value of the tobacco was reduced. The results of the experience of these two years caused the writer to make a grade of "off color," which was used in the 1907 experiment.

In these tests it was not always true that the selection yielding the greatest number of pounds to the acre or grading the highest number of pounds of light wrappers was the most valuable for commercial purposes. In 1905, for instance, the selection No. 3-15-1, which yielded 1,341 pounds of raw tobacco per acre, from which 616 pounds of light wrappers were graded, had a fine appearance when moist, but did not contain substance enough to hold together when put on a cigar. This made it of little value for commercial purposes. Selection No. 13-2-3, which gave a yield of 1,210 pounds and sorted out only 235 pounds of light wrappers, proved to be a very valuable selection, because the quality of the tobacco was such that it could be used on a high-grade cigar with satisfaction. For this reason this selection was looked upon with favor for commercial purposes. It was tested again along with other selections in 1906 and was found to have increased in yield and grade without any deterioration in quality. The showing this selection had made for two years caused it to be chosen for a commercial test in 1907.

In 1907 a contract was entered into between the Department of Agriculture and Mr. Cyrus M. Hubbard, of Sunderland, Mass., under which 3 acres of shade tobacco were to be grown under the supervision of and from seed furnished by the Bureau of Plant Industry. To make Mr. Hubbard secure, a guaranty was given that he would receive at least $750 an acre from the sale of his tobacco. If he did not receive this amount the Department would make up the difference. Mr. Hubbard was to keep an account of all expenditures, so that the cost of production would be accurately known.

The results of Mr. Hubbard's test are as follows:

Cost of producing three acres of shade tobacco in the Connecticut Valley.

6 per cent interest on 3 acres of land valued at $300 an acre	$54.00
6 per cent interest and 5 per cent depreciation on a barn for curing tobacco, valued at $600	66.00
6 per cent interest and 10 per cent depreciation on a tent frame valued at $300	48.00
Repairs to tent frame	14.25

Cloth to cover frame	$548.93
Putting cloth on frame	23.00
Production of seedlings	52.53
Fertilizer	185.25
Applying fertilizer	4.80
Preparation of land	26.05
Transplanting	28.75
Restocking and poisoning	6.00
Cultivation of crop	30.40
Topping and suckering	17.70
Repairs to tent during season	29.76
Straightening up tobacco after storm	2.25
Remodeling shed in which to hang primed tobacco	22.50
Twine for putting on laths on which to string leaves	5.45
Stringing leaves on laths	69.65
Priming and hanging in barn	168.90
Curing and prevention of pole-sweat	25.55
Taking down, stripping, and bundling tobacco	34.50
Delivering tobacco	7.00
Removing cloth from frame	14.25
Cutting tobacco stalks and clearing field	24.50
Total cost	1,509.97

This tobacco was sold to a firm in Hartford, Conn., under the condition that the Department of Agriculture would furnish directions for sorting and packing, the buyers in return to give the Department detailed information as to the cost of packing and grading and to advise the price which was received for the tobacco. The same firm bought another small crop of shade tobacco, part of which was Cuban and part Sumatra, which was packed with the crop bought from Mr. Hubbard. The report furnished to the Bureau of Plant Industry is as follows:

Report on fermentation, grading, and selling of shade-grown tobacco from the Connecticut Valley, May 1, 1908.

COST OF TOBACCO.

Paid C. Hubbard for	4,204 pounds at	$0.55	$2,312.20
Paid Indian Head Plantation Company for	1,574 pounds at	.55	865.70
Paid Indian Head Plantation Company for	733 pounds at	.35	256.55
	6,511		

OUTLAY.

Labor for sorting and baling	$742.90
Labor on bulk	44.20
Cost of mats and crates	77.00
Insurance for six months	35.00
Sundry outlays, receiving, etc	21.00
Interest on investment for six months at 6 per cent	135.63
Total	4,490.18

DETAILS OF HANDLING.

Average cost in bundles	$0.5271
Total number of pounds bought	6,511
Total number of pounds packed	5,993
Loss by shrinkage ... pounds	518

or $7\frac{95}{100}$ per cent.

Cost of sorting, baling, and fermenting in bulk, 15 cents a pound.

5,993 pounds made—

1,400 pounds of light wrappers, or 23+ per cent.
1,425 pounds of medium wrappers, or 23+ per cent.
1,319 pounds of dark wrappers, or 22+ per cent.
891 pounds of seconds, or 14+ per cent.
958 pounds of tops, or 16+ per cent.

Cost of tobacco in bales, 74.92 cents a pound.

Grading of tobacco, 12, 14, 16, 18, 20, 22, and 24 inches, 2,269 pounds being 18 inches long.

The tobacco was sold at prices varying from 38 cents a pound for dark wrappers, seconds, and tops, to $1.75 and $1.85 a pound for 18-inch light wrappers.

SUMMARY.

Net proceeds of sales, 38 bales	$5,076.43
Gross amount invested	4,490.18
Net profits	586.25

From Mr. Hubbard's record of the cost of the production of shade tobacco to the grower and isolating this crop from the buyers' account of the packing and selling of all such tobacco handled, the shrinkage of this particular crop during fermentation and packing being 5.37 per cent, or 226 pounds, the following table showing the net profits to grower and packer is presented:

TABLE II.—*Cost and profits on the growing and packing of a 3-acre plot of shade tobacco in the Connecticut Valley.*

	On 3 acres.	On 1 acre.	On 1 pound.	Basis of computation.
Cost to grower	$1,509.97	$503.32	$0.36	Raw weight.
Price paid to grower	2,312.20	770.73	.55	Do.
Profit made by grower	802.23	267.41	.19	Do.
Initial cost to dealer	2,312.20	770.73	.55	Do.
Cost of packing to dealer	630.60	210.20	.15	Do.
Total cost to dealer	2,942.80	980.93	.70	Do.
Do	2,942.80	980.93	.74	Packed weight.
Price paid to dealer	3,282.86	1,094.29	.82	Do.
Profit to dealer	340.06	113.36	.08	Do.
Total profit made	1,142.29	380.77	.27	Do.

The profits made in growing and handling this lot of shade tobacco would have been greater had it not been for the financial depression and for the fact that so small a quantity can not be handled and marketed to the best advantage.

That the tobacco has merit and will win for itself a place in the market is shown by the following statement from the buyers, located at Hartford, Conn.:

Inclosed herewith please find our report on account sales of the Cuban shade-grown tobacco purchased through your Department last October, in which you will find all of the details and outlays; also the net proceeds which we have received on the amount of tobacco which has been sold.

We are of the opinion that the experiment has been a success on account of now having actual data to base further experiments on. The prices obtained for the various grades of this tobacco have been, in our opinion, their true value; there is, however, no doubt that if the cigar trade had been in a normal condition the entire lot would have been sold some time ago. This tobacco has been sold to cigar manufacturers and leaf-tobacco dealers in various parts of the country, and of the entire number of bales seven were sold direct to cigar manufacturers and the balance to leaf dealers. In each case the first order was for a single bale only, and in every instance we have received duplicate orders, which is the best evidence that the tobacco has merit.

We are of the opinion that this tobacco can be grown profitably in this section and that a demand can be created for same. It being a distinctive type of leaf, it can not be used successfully as a substitute for Sumatra or Connecticut Havana seed, but should be sold and used for what it is. The yield and burning qualities are excellent and the size and shape of the leaf are such as the cigar manufacturers consider profitable.

In regard to the culture and care of this tobacco, too much stress can not be laid on the importance of allowing the tobacco to properly ripen; also, in taking the crop from the curing shed with a sufficient amount of moisture, as the success of bulk-sweating shade-grown tobacco depends largely on the condition of the same when it is placed in the bulk. It should be such that no water would be necessary, either while the tobacco is in the bulk or when it is assorted, and none has been used on the crop which we have handled.

The cost of handling can be reduced by having a larger quantity, but with this small amount it required extra time to look after small details, which has increased the cost of assorting.

We believe that the growers of the Connecticut Valley can grow shade-grown tobacco of the Cuban variety at a profit, but they should commence by growing a few acres only and gradually increase up to 10 acres, which is ample for any one grower to care for.

The following report from the growers shows the initial cost of preparing a small field at Tariffville, Conn., for the growing of shade tobacco, together with the expense of producing the first crop, including that part of the expense of building the frame which should be charged to this crop. This report also shows that it is not practicable to pack such a small crop, because the bales of tobacco are too much broken up to sell to the best advantage.

Report of Cuban-seed tobacco grown on 303 square rods under cloth in the Connecticut Valley.

COST OF LABOR.

Setting posts	$20.66
Erecting wire	10.34
Plowing and preparing ground	6.50
Mixing and sowing fertilizer	7.04

Erecting cloth	$49.67
Taking up and resetting plants	24.64
Hoeing	20.58
Suckering	8.50
Stringing laths	9.73
Topping	2.53
Harvesting	170.68
Pulling stalks	5.22
Stripping	26.74
Miscellaneous	5.83
Superintendence	45.00
Total	423.66

SUMMARY OF COST OF PRODUCTION.

Labor	$423.66
Wire	33.78
Cloth	372.00
Posts	35.00
Fertilizer ($27.60 and $35, barnyard manure; $60, meal)	122.60
Interest on plant and $\frac{1}{20}$ depreciation	66.00
Cuban plants	22.00
Total	1,075.04

CREDITS TO COST ACCOUNT.

One-half cost of cloth	$186.00
Four-fifths cost of poles and setting	44.53
Four-fifths cost of wire and wiring	35.30
Total	265.83
Debits	1,075.04
Credits	265.83
Net cost of production	809.21

Weight of green tobacco in bundles, 2,380 pounds.

The growers refused an offer of 60 cents a pound for their tobacco in the bundle. At this price they would have made clear profits as follows:

On entire field of 303 square rods, producing 2,380 pounds, the gross receipts at 60 cents are	$1,428.00
Cost of production, as per report	809.21
Net profit	618.79
Net profit on 1 acre	326.73
Net profit per pound	.2593

Figuring from another standpoint, the growers would have received over and above all expenses of erecting the frame, producing the crop, etc., a net profit of $352.96 on 303 square rods, or a net profit per acre of $186.38.

From the foregoing data collected from the growing of commercial crops of shade-grown tobacco, the writer does not hesitate to state that any farmer who has suitable tobacco land in the Connecticut Valley can produce this tobacco at a profit, provided he will give it careful attention and handle it so that the leaves will be sound and of good quality.

EFFECT ON TOBACCO OF SIZE OF MESH IN CLOTH USED FOR SHADE.

For the purpose of determining the effect of the size of the mesh in the cloth used for shade on the yield and quality of the tobacco, two selections were planted in 1906 and the rows part way across the field were covered with a cloth having 12 threads to the inch, while the other part of the rows was covered with a cloth having only 8 threads to the inch. The tobacco from each section was harvested, cured, and graded separately. The result is given in Table III:

TABLE III.—*Comparison of the effect of the size of the mesh in cloth used for shade on tobacco in the Connecticut Valley.*

Selection.	Number of threads to inch.	Grade.				Total.
		Light wrappers.	Medium wrappers.	Dark wrappers.	Seconds.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
3-15-1	12	555	128	320	453	1,455
3-15-1	8	464	203	351	328	1,346
13- 2-3	12	333	240	397	184	1,144
13- 2-3	8	212	182	399	142	935

From these records the only conclusion to be made is that cloth containing 12 threads to the inch produces a higher yield and a better quality of tobacco than that which contains only 8 threads to the inch.

THE IMPROVEMENT OF TOBACCO OBTAINED BY SEED SELECTION.

The methods used in selecting tobacco seed to improve the commercial crop have been thoroughly explained in Bulletin No. 91 of the Bureau of Plant Industry[a]. It is the writer's intention here simply to emphasize the fact that tobacco can be greatly improved by seed selection, both as to yield and quality, by giving some data which have been collected in connection with the other experiments. From the data referred to, the records of Type 13 selections are presented in Table IV.

[a] Shamel, A. D., and Cobey, W. W. Varieties of Tobacco Seed Distributed in 1905-6, with Cultural Directions. 1906.

TABLE IV.—*Record of three years' breeding in Type 13-2-3.*

Year.	Selection.	Wrappers.	Seconds.	Total yield.
		Pounds.	*Pounds.*	*Pounds.*
1905	13-2-3	859	304	1,163
1906	13-2-3	970	184	1,154
1907	13-2-3	1,153	187	1,340

Table IV shows that for the three years specified the number of pounds of wrappers was increased and that the seed plants selected in 1906 gave a substantial increase in yield and quality over the 1906 crop.

THE STERILIZING OF SEED BEDS.

The sterilizing of seed beds is a new and very important feature in the production of tobacco seedlings. This practice was brought about by the general prevalence of a disease known as *Thielavia basicola,* which attacked the roots of the young plants and completely destroyed them. This disease made its appearance in 1905 and seemed to spring up spontaneously in several sections of the Connecticut Valley. It was of so serious a nature that experiments were made at once with a view to checking its growth.

In the spring of 1907 the writer conducted a series of experiments on a very badly diseased bed. Sections of the bed were sterilized with steam; with formalin, 1 to 200 parts of water, applied at the rate of 1 gallon to the square foot of seed bed, and with surface fire.

The steam sterilization proved to give the best satisfaction, this method[a] not only killing the fungi, but destroying all weed seeds. The results were so satisfactory that this practice was recommended to the farmers, and a number of them used it in the season of 1908 with excellent results.

The beds are sterilized after they have been prepared for the seed and just before the seed is sown. A galvanized pan 10 by 6 feet and 6 inches deep (see Pl. IV, fig. 2) is inverted and the edges are pushed down into the soil 1 or 2 inches. The pan is connected with a steam boiler by means of a steam hose, and live steam is run into the pan for about forty minutes under a pressure of from 100 pounds up. The higher the pressure the more thoroughly the soil will be sterilized.

To get the results and ascertain the effectiveness of steam sterilization of seed beds, the following circular was sent out on June 17, 1908, to all growers who sterilized their beds:

In order that we may get an idea of the value of steam sterilizing of seed beds for the production of tobacco plants, will you kindly answer the following questions and return this sheet in the inclosed envelope?

[a] Devised by Mr. A. D. Shamel, of the Bureau of Plant Industry.

How many years have you sterilized?
How many square feet of seed bed did you sterilize?
How many minutes did you sterilize each section?
Did you have any weeds on your sterilized bed?
Did the plants do as well on the sterilized bed as they did on the unsterilized beds?
Were the plants as hardy on the sterilized beds?
Did the beds require more water when sterilized?
How much did it cost you to sterilize your beds?
How much did you gain by sterilizing?
Do you wish to sterilize next year?
Do you consider steam sterilizing of seed beds practicable and profitable?
Give below any other information you can relative to the effectiveness or advantages of steam sterilizing of tobacco beds.

In reply to this circular of inquiry the data given in Table V were received.

TABLE V.—*Area of tobacco seed beds sterilized and results of such sterilization.*

Name.	Address.	Square feet sterilized.	Cost of sterilizing.	Gain by sterilizing.	Remarks.
M. Barns	Southwick, Mass	750	$4.80	$15.00	Grew faster.
W. Griffin	do	600	5.00	5.00	Grew faster.
L. Wetherby	do	720	4.25	20.00	Plants earlier.
A. H. Coe	do	300	2.00	15.00	Plants earlier.
F. B. Griffin	Bloomfield, Conn	4,000	30.00	40.00	Plants earlier.
Total		6,370	46.05	95.00	

It will be noted that the cost of sterilizing 6,370 square feet was $46.05, or 0.72 cent per square foot, while the financial gain over and above the cost was $95, or 1.5 cents per square foot. In every case the plants from the sterilized beds did better, grew faster, and were more healthy than those from unsterilized beds, and in consequence all the farmers named in Table V intend to sterilize again next year.

The results obtained from the steam sterilization of the soil make it safe to recommend to every farmer that he employ this method upon his tobacco seed beds.

CONCLUSIONS.

From the results of actual experiments it is evident that tobacco can be produced profitably in the Connecticut Valley under shade, provided the grower will obtain a good strain of seed and start in on a small scale until he gets some experience in growing and handling the crop.

The best cloth to use for shade is one with twelve hard twisted threads to the inch.

In order to insure an abundance of good healthy plants the seed beds should be sterilized.

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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 139.

B. T. GALLOWAY, *Chief of Bureau.*

AMERICAN MEDICINAL BARKS.

BY

ALICE HENKEL,

ASSISTANT, DRUG-PLANT INVESTIGATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., September 1, 1908.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 139 of the series of this Bureau the accompanying manuscript, entitled "American Medicinal Barks." This paper was prepared by Miss Alice Henkel, Assistant in Drug-Plant Investigations, and has been submitted by the Physiologist in Charge with a view to its publication.

Thirty-five drugs are fully described, and under many of the descriptions briefer information concerning closely related species is included. All of the "official" barks obtained from trees and shrubs occurring in this country are described, as well as many "nonofficial" ones.

This bulletin forms the second installment on the subject of American medicinal plants, the first one treating of American root drugs, and has been prepared to meet the steady demand for information concerning the medicinal plants of this country. It is intended as a guide and reference book for those who may be interested in the study or collection of the medicinal plants found in the United States.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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AMERICAN MEDICINAL BARKS.

INTRODUCTION.

Among the manifold uses of the trees of our forests not the least important is the utilization of their barks for medicinal purposes.

While the "official" barks—that is, those that are recognized in the Eighth Decennial Revision of the United States Pharmacopœia—number only seventeen in all, twelve of which are furnished by trees and shrubs growing in the United States either as native or introduced species, there are many others which are nevertheless used in medicine to a considerable extent by one or another school of practitioners. All of the "official" barks are described in this bulletin, and an effort has been made to include such "nonofficial" ones as seemed to be most in demand, judging from the trade catalogues of wholesale dealers in crude drugs, but a number of others that are not so much used have been omitted on account of lack of space. The number of drugs fully described is thirty-five, but under many of the descriptions closely related species are also briefly treated.

Many factors have contributed to the destruction of our forests. Beginning with the settlement of this country, when land had to be cleared of timber to make way for homes, and on through the centuries there have been steady and increasingly heavy drafts upon our natural forest resources by an increasing population and the building up of various new enterprises, and until within very recent years with little or no thought for the needs and welfare of generations to come. In the collection of barks, too, may be seen another instance contributing in a measure to the depletion of our forests; for too often trees are felled and killed outright simply for the sake of obtaining the bark, or a tree is peeled to such an extent that death is certain to result. When it is considered that of cascara sagrada (*Rhamnus purshiana*) alone about 100,000 trees are annually sacrificed, and that the oak, pine, elm, birch, poplar, willow, and larch all contribute their quota of bark, it will be seen that at no very distant date more careful methods of bark collection and the replanting of now de-

nuded areas will be needed. The Forest Service of the United States Department of Agriculture has issued Forest Planting Leaflets, giving full information in regard to the planting and propagation of many of our forest trees, and anyone interested in the subject can have these leaflets for the asking.

The statements herein regarding medicinal uses are based on the information contained in various dispensatories and other works relating to materia medica, and in a publication of the character of this bulletin can, of course, be referred to only in the most general manner. It is not the purpose herein to prescribe the use of any of these barks for medicinal purposes; such use should be made only under the direction of a physician.

The writer is indebted to Mr. George B. Sudworth, Dendrologist of the Forest Service, for an examination of the manuscript and for the use of a number of photographs taken by him and other members of that Service.

Other illustrations in this bulletin have been reproduced from photographs taken from nature by Mr. C. L. Lochman, and use has also been made of a number of illustrations found in the Handbook of the Trees of the Northern States and Canada, by Mr. R. B. Hough.

The writer also wishes to gratefully acknowledge information of various kinds furnished by wholesale drug dealers.

THE COLLECTION OF BARKS.

As with other medicinal portions of plants, the best time to collect the barks is at a period when the greatest quantity of the active constituents is contained therein. In the case of barks this is in early spring, before active growth takes place, or in late fall or even winter.

There are various methods of obtaining the bark. In some cases the outer corky layer is first shaved off before the bark is peeled, a process which is known as "rossing." This is generally done where the outer layer is considered inert. Then incisions a few inches wide are made, and, depending upon the nature of the bark, sometimes strips several feet in length are peeled. The barks of some branches or roots are removed by making long, lengthwise incisions, permitting the bark to be readily slipped off, or in other cases the bark is first loosened by pounding with a mallet.

After collection, the bark is taken to a clean, well-aired place for drying, spread out on shelves or on the floor and protected from moisture. Barks contain less moisture and absorb less moisture than other parts of plants, but they nevertheless need to be protected from wet weather. Sometimes barks are strung on wires or strings to facilitate drying.

When the barks are thoroughly dried and have been broken or cut up into suitable lengths, they may be packed in dry, clean barrels or other proper containers ready for shipment.

It will be well to repeat here what has been said in the first of this series of papers, entitled "American Root Drugs," with regard to the advisability of correspondence with crude-drug dealers previous to shipment, in order to ascertain whether a particular drug is desired, how large a quantity is wanted, and what price will be paid. Samples representative of the drug to be disposed of should be sent at the same time.

It is necessary also to emphasize the fact that the prices given in this bulletin are approximations only, being those paid at the present writing, and it must be remembered that before this bulletin is off the press a drug now listed at 10 cents a pound may have declined to 5 cents or less, while a drug quoted at 2 cents may be worth 5 or 10 cents or more. The object in noting prices is simply to give prospective collectors an idea of the range of prices, but with the constant fluctuations that take place in the drug market it will be readily understood that these prices can be but remotely approximate and that the actual price to be paid can be ascertained only through correspondence with drug dealers.

TREES AND SHRUBS FURNISHING MEDICINAL BARKS.

Each section contains synonyms and the pharmacopœial name, if any, the common names, habitat, range, descriptions of the tree or shrub, as well as of the bark as found in commerce, and information concerning collection, prices, and uses.

Bittersweet (*Solanum dulcamara*) is the only one of American medicinal plants of which the young branches alone are used, but it is nevertheless given a place with the barks, as it can more properly be included in this series than in any other.

WHITE PINE.

Pinus strobus L.

Other common names.—Northern pine, Weymouth pine, American white pine, American deal-pine, soft deal-pine, spruce-pine.

Habitat and range.—The white pine, indigenous to this country, occurs in woods from Canada south to Georgia and Iowa.

Description of tree.—This large, handsome evergreen tree—sometimes 200 feet in height and with a straight trunk measuring 3 to 4 feet in diameter—has horizontal branches, both trunk and branches covered with a smooth, grayish green bark when young, becoming dark and rough with age, and longitudinally fissured. The wood is soft and white, and much used for flooring, etc.

The slender, pale green leaves, or needles, are usually five in a sheath, about 3 to 5 inches long, the flowers rather inconspicuous, and the cones cylindrical, drooping, sometimes slightly curved, resinous, about 5 to 10 inches long and about an inch in thickness, but much wider after the scales spread apart, which generally occurs in September, allowing the seeds to fall out. (Fig. 1.) It requires two seasons for the cones to mature. The white pine belongs to the pine family (Pinaceæ).

FIG. 1.—White pine (*Pinus strobus*), leaves and cones.

Description of bark.—The inner bark of the white pine is the part employed medicinally. It occurs in flat pieces of irregular size, about an eighth of an inch in thickness, brownish on the outside, the inner surface sometimes lighter colored and sometimes darker than the outside, smoothish, and marked with fine grooves. It breaks with a tough, fibrous fracture, and has a slight turpentine odor. The taste is described as "mucilaginous, sweetish, bitterish, and astringent."

Prices and uses.—At present collectors are paid from about ½ to 3 cents a pound.

White pine bark is used as an expectorant, forming one of the ingredients in the sirup which bears its name, which is much used for coughs and colds to facilitate expectoration.

TAMARACK.

Larix laricina (Du Roi) Koch.

Synonym.—*Larix americana* Michx.

Other common names.—American larch, black larch, red larch, hackmatack.

Habitat and range.—This tree frequents swamps and moist places from Canada south to New Jersey, Indiana, and Minnesota. It is native in this country.

Description of tree.—In spring the light green, feathery appearance of the young leaves of the tamarack make it a rather conspicuous and attractive tree. It is a slender tree belonging to the pine family (Pinaceæ), but unlike other members of this family, except bald cypress, it loses its leaves upon the approach of winter. The bark is thin and close, finally becoming scaly. The wood, which is light brown in color, hard and resinous, is strong and durable.

FIG. 2.—Tamarack (*Larix laricina*), leaves and cones.

The tamarack has horizontally spreading branches, and reaches a maximum height of 100 feet. The pale green leaves, which appear early in spring, are short, very slender, and needle shaped, from 20 to 40 together in a fascicle, or bundle, similar to the manner in which pine needles grow, except that they are without sheaths (fig. 2).

The aments, or flower clusters, are inconspicuous, and are of two kinds, staminate or male, and pistillate or female. The female clusters have a reddish and greenish tinge, and develop later into small erect cones, resembling in miniature cones of some of the pines and spruces (fig. 2).

Description of bark.—The tamarack bark, as found in the stores, is in rather large, coarse pieces or slabs, having the outer layer removed. The outer surface has a rather fibrous appearance, cinnamon brown in color, occasionally showing patches of brownish red or almost purplish where the outside layer has been imperfectly shaved off; the inner surface is smooth and light brown. The whole breaks with a somewhat woody fracture, showing ragged, splintery edges. The odor is rather strong and disagreeable.

Prices and uses.—Tamarack bark at present is paid for at the rate of from 1½ to 3 cents a pound.

The bark, in decoction, is said to be useful as a tonic and alterative, and also as a laxative and diuretic.

Fig. 3.—Aspen (*Populus tremuloides*), trunk.

ASPEN.

Populus tremuloides Michx.

Other common names.—White poplar, American poplar, trembling poplar, American aspen, mountain-asp, quaking asp, quiverleaf, auld-wives'-tongues.

Habitat and range.—The aspen is found in dry or moist soil from northern Canada and Alaska south to the mountains of Pennsylvania, to southern Illinois, northwestern Missouri, and in the Rocky Mountains to Lower California.

Description of tree.—The greatest height attained by the aspen is 100 feet, with a trunk measuring about 3 feet in diameter. It is a native of this country and belongs to the willow family (Salicaceæ). The branches and trunks of the younger trees are covered with a smooth, light grayish green bark, but on older trees the bark becomes dark and deeply fissured (fig. 3). The young unfolding leaves are whitish and woolly, but become smooth as they expand. The leaves are broadly oval or rounded, with a somewhat heart-shaped base, a short-pointed apex, and finely round-toothed or frequently saw-toothed margin (fig. 4). They are about 1½ to 2 inches in length, and are borne on long, slender stalks which are flattened on the sides, causing the leaves to be set in

motion by the slightest breeze and to quiver and tremble almost continually, which has given rise to some of the tree's common names, such as quaking asp, trembling poplar, and quiverleaf. Early in spring, before the leaves are out, the drooping catkins appear, the staminate (male) from 1½ to 2½ inches long, the pistillate (female) crowded and longer. The capsules which follow are conical in shape, pointed, and two-valved (fig. 4).

FIG. 4.—Aspen (*Populus tremuloides*), leaves and capsules.

Description of bark.—This bark generally occurs in straight pieces from about 2 to 5 inches long and about one-fourth to one-half inch wide. The outside is grayish and smoothish except here and there where marked with lenticels. The inner surface is somewhat rough to the touch, light colored to brownish. The fracture is even, somewhat corky, and the odor faintly aromatic.

Collection, prices, and uses.—The bark of the aspen, or white or American poplar, as it is often known in the drug trade, is collected in spring, and collectors are paid from about 1 to 4 cents a pound.

It is used for its tonic properties, and has also been employed in the treatment of intermittent fever.

As in the case of the willows, to which family (Salicaceæ) the poplars belong, the glucoside salicin is also obtained from the barks of the various species of Populus.

WHITE WILLOW.

Salix alba L.

Other common names.—Salix, common European willow, duck-willow, Huntington willow.

Habitat and range.—The white willow has been introduced into this country from Europe, and has sparingly escaped from cultivation. It occurs in wet soil along streams from Pennsylvania northward to New Brunswick and Ontario.

Description of tree.—This is a tree of very rapid growth, and attains quite a size, sometimes 90 feet in height, with a trunk perhaps 6 feet in diameter. There is a group of willows known as "crack willows," on account of the brittleness of the twigs where they are attached to the branches, and the white willow belongs to this group, as does the "crack willow," or "brittle willow," (*S. fragilis*), mentioned farther on. All of the species described are members of the willow family (Salicaceæ).

The gray and rough-barked white willow has lance-shaped leaves, pointed at the apex and narrowed at the base, and with saw-toothed margins. When young, both sides of the leaves are covered with silky hairs, but as they mature they become less hairy and are pale green on the lower surface, or covered with a "bloom."

The long, loose, green, cylindrical aments, or catkins, are staminate and pistillate and are borne on different trees, appearing with the leaves in spring.

A variety of this species, with yellowish green twigs and with leaves smooth on the upper surface, is known as golden osier (*S. alba* var. *vitellina* (L.) Koch), and is the most common form found in North America.

Description of bark.—The white willow bark of commerce is generally in tough, flexible strips, the outer surface smooth or slightly wrinkled, and of a yellowish brown or grayish brown color. The inner surface varies from a light brown to darker brown, and is marked with long, fine lines. White willow bark has a bitter, astringent taste, but practically no odor.

Collection, prices, and uses.—The best time to collect white willow bark is in the spring when the sap begins to flow, at which time it is easy to remove.

White willow bark should not be kept very long, as the salicin content diminishes with age. This bark itself is not official in the United States Pharmacopœia, but the glucoside salicin obtained from it is so recognized. The medicinal properties of willow bark depend upon its two most important constituents, salicin and tannin.

Salicin has tonic, antiperiodic, and febrifuge properties, and is occasionally employed in rheumatic affections.

The wood of white willow furnishes a very pure charcoal which is used in the manufacture of gunpowder. The young branches, known as osiers, are much used in the manufacture of baskets, etc.

The prices paid to collectors range from 2 to 5 cents a pound.

Other species.—Roughly speaking, the willows, or Salix species, may be said to be divided into two classes, those with yellowish twigs and those with reddish or purplish twigs. Most of the yellow-barked species belong to the "crack willows," which have their twigs attached in such a manner that they break off very easily. It is claimed that the red or purple barked twigs contain the most salicin, while those with yellow twigs are richest in tannin.[a]

Of those containing the most salicin may be mentioned the crack willow, or brittle willow (*Salix fragilis* L.). This, a native of Europe, has escaped from cultivation in this country, and occurs from Massachusetts to New Jersey and Pennsylvania. It is a tall and slender tree, the trunk covered with a rough gray bark, and the twigs with reddish green bark. At the point of attachment the twigs are very fragile and break off readily. The twigs when planted grow very rapidly. The leaves are 3 to 6 inches in length, long pointed and narrowing toward the base, smooth, dark green on the upper surface, and of a lighter color underneath, and with margins slightly toothed. The flowers appear in April or May; the fruiting catkin is rather loose and about 3 to 5 inches in length, while the staminate or male catkin is only about 1 or 2 inches long.

Another species employed in medicine is the black willow, pussy-willow, or swamp-willow (*Salix nigra* Marsh). This is a native willow and occurs along the banks of rivers from Canada to Florida; it is not found west of the Great Plains, except in southern New Mexico and Arizona and isolated in California. It is tall and has a rough dark brown or black bark, and brittle yellowish branches. The leaves are narrowly lance shaped, and the catkins (pussy-willows) appear about the same time as the leaves, the male catkins about 1 to 2 inches long, and the female catkins as long as 3 inches, spreading apart in fruit. The bark of this species is used in medicine and the fresh aments, or catkins, are also employed.

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[a] The National Standard Dispensatory, 1905.

BAYBERRY.

Myrica cerifera L.

Other common names.—Wax-myrtle, candleberry, candleberry-myrtle, waxberry, tallow-bayberry, tallow-shrub, bayberry wax-tree, American vegetable tallow-tree, vegetable-tallow, American vegetable-wax.

Habitat and range.—The bayberry, which is indigenous, is found in sandy swamps or wet woods from Texas and Florida northward to Arkansas and along the coast of Maryland. In its southern home it is a small evergreen tree, but as it goes farther north it becomes, successively, a tall semideciduous shrub or a dwarfed and deciduous shrub.

Description of tree.—The greatest height attained by the bayberry is about 40 feet, but it is usually only 3 to 12 feet high. It is slender, with a gray, smoothish bark. The leaves, when crushed, have a fragrant odor, and are 1 to 4 inches long, narrow, dark green and shining above, lighter colored and dotted with resin cells beneath, and generally with margins entire (fig. 5).

FIG. 5.—Bayberry (*Myrica cerifera*), leaves and fruit.

The flowers appear from about March to May, according to locality, and generally before the leaves are fully expanded. They are borne in aments, or spikelike clusters, the male and female flowers being produced on separate trees. The yellowish aments bearing the staminate or male flowers are cylindrical, while the pistillate or female aments are oblong, shorter than the staminate, and greenish. The fruit, which remains on the tree for several years, consists of clusters of round, bluish white berries having a granulated appearance and covered with a greenish white wax (fig. 5). Each berry contains one seed. The bayberry belongs to the bayberry family (Myricaceæ).

Description of bark.—As found in commerce, bayberry bark occurs in curved or quilled pieces, sometimes only about an inch in length and sometimes 6 inches or more. The outside is covered with a thin corky layer, which is whitish and somewhat fissured. Underneath this layer the dark reddish brown, smooth bark may be seen. The inner surface of the bark is also reddish brown, but marked with faint lines. The fracture is light red and granular. The bark, when powdered, has a pungent, aromatic odor, causing sneezing and coughing, and the taste is bitter, pungent, and acrid.

Collection, prices, and uses.—Late autumn is the best time to collect this root, and after it has been thoroughly cleaned and while still fresh the bark is loosened and removed by beating the root with a mallet or similar instrument.

Bayberry bark brings from 2 to 5 cents a pound. It is used for its tonic and astringent properties.

The wax obtained from the berries is used for making candles.

BUTTERNUT.

Juglans cinerea L.

Other common names.—Juglans, white walnut, lemon-walnut, oilnut.

Habitat and range.—The butternut tree, which is indigenous to this country, is of common occurrence in rich woods from New Brunswick to North Dakota and south to Georgia, Mississippi, and Arkansas.

Description of tree.—This much-branched tree, belonging to the walnut family (Juglandaceæ), is generally from 30 to 50 feet in height, rarely exceeding 100 feet, and when old has a thick, rough, brownish gray, furrowed bark (fig. 6), and the twigs, leaf stems, and leaflets, especially in the early stages of growth, are furnished with sticky hairs.

Fig. 6.—Butternut (*Juglans cinerea*), trunk.

The yellowish green leaves are composed of from 11 to 19 leaflets, all stemless except the terminal one; the leaflets are 2 to 3 inches long, oblong lance shaped and long pointed at the apex, rounded or blunt at the base, and toothed. The flowers are produced in May, or about the same time as the leaves, the yellowish green male catkins 3 to 5 inches in length, and the female flowers in clusters of 6 to 8 flowers each. In October the sweet and oily oblong nut matures, enveloped in a strong-smelling, sticky husk. The edible nut itself has a thick, hard shell, which is marked with deep furrows or lines.

Description of bark.—Butternut bark, from the root collected in autumn, was official in the United States Pharmacopœia for 1890. It occurs in quilled pieces varying in length, and about an eighth of an inch or a trifle more in thickness, deep brown and smoothish or somewhat scaly on the outside, the inner surface likewise brown and with parts of the thin, stringy inner layer of the bark attached. It breaks with a short, fibrous fracture, finely checkered with white and brown. The odor is faint, and the taste bitter and acrid.

Collection, prices, and uses.—Butternut bark, which will bring the collector from 1 to 4 cents a pound, is taken from the root collected in autumn. Its use in medicine is that of a mild cathartic and tonic.

IRONWOOD.

Ostrya virginiana (Mill.) K. Koch.

Synonym.—*Carpinus virginiana* Mill.

Other common names.—Hop-hornbeam, deerwood, leverwood, black hazel, Indian cedar.

Habitat and range.—The ironwood is indigenous to this country, and is common in rich woods in Canada and the eastern United States, and westward to Minnesota and Texas. It is occasionally cultivated.

Description of tree.—This usually slender tree attains its greatest height, sometimes 50 feet, in the western part of its range, while farther eastward it grows only about 15 to 20 feet high. The brownish trunk is finely furrowed in short, lengthwise lines. The wood is very hard and heavy, and is employed in making farm implements.

The leaves somewhat resemble those of the sweet birch, to which family (Betulaceæ) this tree belongs, but they are rough to the touch, instead of smooth and shining like the birch leaf. They are from 2½ to 4 inches in length and about an inch or more in width, oval or oblong-oval in shape, long pointed at the apex, and rounded at the base, and with margins very sharply double toothed. The upper surface of the leaves is usually smooth, except sometimes slightly hairy on the veins, while the lower surface is hairy or even woolly. (Fig. 7.) The green, inconspicuous flowers are borne in catkins, male and female, and are produced from April to May. The male catkins are cylindrical, and about 1½ to 3 inches long, while the female catkins are short, maturing in July or August into large fruiting cones from 1½ to about 2½ inches in length, and very much resembling hops (fig. 7).

FIG. 7.—Ironwood (*Ostrya virginiana*), leaves and fruit.

Description of wood and bark.—The inner wood and the bark, which are bitter, are the parts employed in medicine. The wood is white, very hard and strong, and occurs in pieces a few inches in length and of varying thickness. The bark as found in the stores is in flat pieces about 2 inches in length; the outside grayish green with thin, short scales; the inside brown, marked with long fine lines or ridges, and generally with considerable of the woody portion adhering. There is practically no odor.

Prices and uses.—At present the price paid to collectors runs from about 5 to 6 cents a pound.

Ironwood is used for its tonic, alterative, and antiperiodic properties.

SWEET BIRCH.

Betula lenta L.

Other common names.—Black birch, cherry-birch, spice-birch, river-birch, mahogany-birch, mountain-mahogany.

Habitat and range.—This indigenous tree occurs in rich woodlands from Newfoundland to Ontario, south to Florida and Tennessee.

Description of tree.—Sweet birch, which somewhat resembles the cherry tree, attains a height of from 50 to 80 feet, and has brownish red, sweet, and aromatic bark. The bark of the trunk of older trees is rather thick, as much as

one-half inch, and has rough, platelike fissures (fig. 8). The younger branches are covered with a beautiful, shining, reddish brown bark, with a layer of yellowish green beneath the surface, and furnished with numerous small, whitish spots, known technically as "lenticels," and which may be designated as "breathing pores." In most of the birches the bark comes off in layers, but this is not the case with the sweet birch. The youngest twigs of the sweet birch are densely hairy. The wood is much used in cabinet work, being fine and close grained, and taking on a very high polish. It has a rosy color when first cut, which becomes darker by exposure.

FIG. 8.—Sweet birch (*Betula lenta*), trunk.

The young leaves are covered with shining, silvery, silky hairs, but as they grow older these disappear almost entirely. In shape the leaves are oval or oblong-oval, acute or acuminate at the apex, somewhat heart shaped at the base, and sharply toothed; they are about 3 to 4 inches long and 1 to 2 inches wide, smooth, bright green and shining on the upper surface, and dull green on the lower surface with hairy veins. (Fig. 9.) Like the bark, the leaves are also aromatic.

The flowers are of two kinds, staminate or male and pistillate or female, and are borne in separate catkins or slender spikes. The male catkins are in drooping clusters 2 to 3 inches long, while the female catkins are shorter, only about 1 inch or less in length, thicker, stemless, and nearly erect. (Fig. 9.) They expand with the leaves or before, about April or May. The cylindrical, conelike fruit is about an inch in length. The sweet birch belongs to the birch family (Betulaceæ).

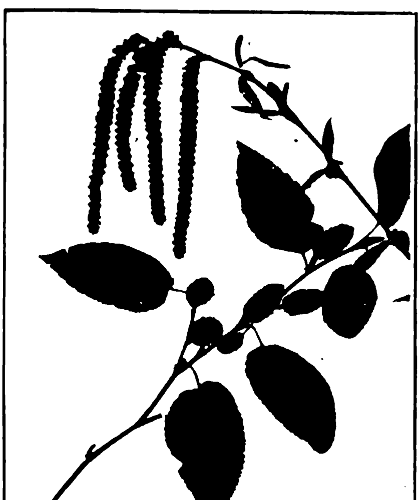

FIG. 9.—Sweet birch (*Betula lenta*), leaves, catkins, and fruit.

Description of bark.—The birch bark of commerce consists of pieces of irregular size, generally reddish brown and smooth on the outside, the thin outer layer having been removed, but with pieces of it sometimes adhering. The inner surface is also reddish brown and smooth. Birch bark breaks with a clean, even, somewhat granular fracture.

Collection, prices, and uses.—The bark is collected in late summer. It furnishes the oil of sweet birch or oil of Betula, official in the United States Pharmacopœia, and obtained by maceration and distillation. It is almost identical

with wintergreen oil, and is employed for similar purposes. Both bark and oil are used for flavoring. Birch bark will bring from about 1 to 3 cents a pound.

The bitter, aromatic leaves are also used in domestic practice, and birch beer is made from the sweet sap.

TAG-ALDER.

Alnus rugosa (Du Roi) K. Koch.

Synonym.—*Alnus serrulata* Willd.

Other common names.—Common alder, red alder, smooth alder, green alder, American alder, speckled alder, swamp-alder, notch-leaved alder.

Habitat and range.—Tag-alder is found in swamps and along the marshy banks of streams from New England south to Florida and Texas, and westward to Ohio and Minnesota. It is a native of this country.

FIG. 10.—Tag-alder (*Alnus rugosa*), leaves, catkins, and fruit.

Description of tree.—Sometimes the tag-alder, which belongs to the birch family (Betulaceæ), attains the height of a tree, but more often it is only a shrub, growing from 5 to 20 feet high, with a smooth brownish gray bark. The leaves are 2 to 4½ inches long, oval, somewhat leathery, green above and below, the apex round or blunt, and the base narrowed or rounded, the margins minutely but sharply toothed. The flowers are produced before the leaves are out, early in spring, about March or April. They are reddish green, the female flowers borne in an erect catkin, while the male flowers are borne in a drooping catkin. The small, oval, conelike fruit usually remains on the shrub throughout the winter. (Fig. 10.)

Description of bark.—As it occurs in commerce, tag-alder bark is in straight, curved, or occasionally quilled pieces of varying length and width, but generally broken up into rather small pieces, the outer surface brownish gray or greenish gray and smoothish, the inside cinnamon colored and closely and coarsely ridged. It breaks with a sharp, even fracture. The odor is strong and rather aromatic, and the taste astringent and bitter.

Prices and uses.—The amount paid to collectors ranges from 1 to 4 cents a pound.

Tag-alder bark is used in medicine for its astringent, alterative, and emetic properties.

WHITE OAK.

Quercus alba L.

Pharmacopœial name.—Quercus.

Other common names.—Stone-oak, stave-oak.

Habitat and range.—The white oak is found in woods from Maine to Minnesota, south to Florida and Texas, but is most abundant in the Middle States. It is indigenous to this country.

Description of tree.—In dense woods this stately tree sometimes reaches a height of 150 feet. Usually it is about 60 to 80 feet high, the trunk about 3 to 4 feet in diameter, and with many wide-spreading branches. The bark is grayish and comes off in thin scales (fig. 11). When young, the leaves are red and hairy, becoming smooth and thin when older, with a light green upper surface and paler lower surface furnished with prominent veins. In autumn they turn a beautiful red. The leaves are 4 to 7 inches long, and about half as wide, borne on stems about half an inch in length; they are divided into from 3 to 9 oblong, blunt lobes, with entire or toothed margins (fig. 12). About the time that the leaves appear, the very small greenish or yellowish flowers are produced. The male flowers are borne in slender, usually drooping aments, or spikelike clusters, and the female flowers singly. The fruits (acorns) mature the first autumn, and are about 1 inch in length, about one-fourth covered by the scaly cup (fig. 12). The white oak is a member of the beech family (Fagaceæ).

FIG. 11.—White oak (*Quercus alba*), trunk.

Description of bark.—The dried bark of the white oak is official in the United States Pharmacopœia. As found in the stores it is in nearly flat pieces about one-eighth of an inch or more in thickness, rough and fibrous on the outside, with the outer layer removed, brownish, and the inside with short, coarse grooves, the whole breaking with a coarse, tough, and splintery fracture. The odor is rather strong, reminding one somewhat of tanbark, and the taste very astringent. The Pharmacopœia adds that it does not tinge the saliva yellow when chewed.

FIG. 12.—White oak (*Quercus alba*), leaves and acorns.

Collection, prices, and uses.—The best time for collecting white-oak bark is in the spring, as at that time it is said to contain the greatest amount of tannic acid. The outer layer is first scraped off. As directed by the United States Pharmacopœia, the bark should be "collected from trunks or branches 10 to 25 years of age, and deprived of the periderm."

The price paid for white oak bark ranges from 1 to 3 cents a pound. The bark is a powerful astringent and is also antiseptic.

SLIPPERY ELM.

Ulmus pubescens Walt.

Pharmacopœial name.—Ulmus.

Synonym.—*Ulmus fulva* Michx.[a]

Other common names.—Moose-elm, red elm, Indian elm, rock-elm, sweet elm.

Habitat and range.—This tree is native in woods, along streams, and on hills from Quebec to North Dakota, south to Florida and Texas. It is more common in the western part of its range.

Description of tree.—The slippery elm is usually about 40 to 50 feet in height, although it will sometimes grow as tall as 70 feet, with a trunk about 2½ feet in thickness. In dense woods it grows tall and straight, branching some distance from the ground, but in open woods and fields, where it often occurs singly, it is more spreading and irregular in growth. It has a dark, reddish wood, hard and durable, and is covered with a rough, reddish brown bark (fig. 13). Even the small branches are rough and the twigs are furnished with rough hairs. The leaf buds, a few weeks before expanding, are soft and downy with rust-colored hairs. Short downy stalks support the rather large leaves, the upper surface of which is very rough and the lower hairy. The leaves are about 4 to 8 inches long and about 2 to 2½ inches wide, pointed at the apex, usually lance-shaped oval in outline, sharply toothed, and with an obtuse, unevenly shaped and generally heart-shaped base. The flowers appear very early in the spring (in March or April), before the leaves. They occur in dense, lateral clusters and consist of a bell-shaped, downy calyx, usually 7 lobed, no corolla, and 5 or 7 reddish stamens. The winged fruit which follows, known botanically as a "samara," is flattened and circular; the seed is borne in the center, surrounded by the winged, membranous margin, which aids its dispersion by the wind (fig. 14). Slippery elm belongs to the elm family (Ulmaceæ).

FIG. 13.—Slippery elm (*Ulmus pubescens*), trunk.

Description of bark.—The commercial article consists of pale brown or whitish brown flat pieces tied in bundles, and it also occurs on the market in smaller pieces of uneven size, suitable for grinding purposes, but which bring a lower price. The flat pieces are of varying length and width, about an eighth of an

[a] The pharmacopœial usage.

inch in thickness, the outer bark having been removed in accordance with the requirements of the Pharmacopœia, but sometimes patches of it are still found adhering. They are tough, and break with a fibrous fracture. The inner surface is yellowish brown and marked with fine furrows. Slippery elm has a faint, peculiar odor, and a mucilaginous but insipid taste.

Collection, prices, and uses.—The outer bark is rossed or shaved off before removing the inner bark from the tree, which alone is recognized as official in the United States Pharmacopœia. It is taken from the tree in long strips, and generally dried under pressure so that it will remain flat.

The price paid for slippery elm bark is from 3 to 10 cents a pound, depending upon quality, the small, irregular pieces having less value than the large, flat pieces.

The mucilaginous character of slippery elm bark renders it useful in relieving coughs, and it is also employed in treating diarrheal complaints. It is soothing and allays inflammation, and is also somewhat nutritious. In certain sections of the country poultices are made from the bark and applied to abscesses.

FIG. 14.—Slippery elm (*Ulmus pubescens*), leaves, flowers, and fruits.

MAGNOLIA.

(1) *Magnolia acuminata* L.; (2) *Magnolia tripetala* L.; (3) *Magnolia glauca* L.

Synonyms.—(2) *Magnolia umbrella* Lam.; (3) *Magnolia virginiana* L.

Other common names.—(1) Cucumber-tree, mountain-magnolia, blue magnolia; (2) cucumber-tree, umbrella-tree, elkwood; (3) sweet bay, white bay, sweet magnolia, beaver-tree, swamp-sassafras, swamp-laurel.

Habitat and range.—(1) *Magnolia acuminata* occurs in the mountainous regions from New York to Georgia, but is most abundant in the Southern States; (2) *Magnolia tripetala* grows in rather moist, rich soil; it is nowhere very common, but is widely distributed in the Appalachian Mountain region; (3) *Magnolia glauca* is found in swamps and swampy woods from Massachusetts to the Gulf of Mexico.

FIG. 15.—Cucumber-tree (*Magnolia acuminata*), leaves.

Descriptions of trees.—Magnolia acuminata, which is native in this country, reaches a height of from 60 to 80 feet, the trunk straight, from 4 to 5 feet in diameter, and with a rough, dark gray bark. The leaves are 6 to 10 inches long and about 3 inches wide, oval and thin, pointed at the apex, and generally rounded at the base; they are pale green underneath and somewhat hairy, especially along the veins (fig. 15). The numerous, slightly fragrant flowers, which appear from May to June, are rather large, measuring 5 to 6 inches across, oblong bell shaped, greenish yellow with a bluish tinge, and having 6 to 9 obovate petals. The cylindrical, fleshy fruit cone, about 3 inches in length, turns rose colored as it matures. In form it resembles a small cucumber, whence the name "cucumber-tree" is derived. When ripe, the several capsules composing these cones burst open, disclosing bright scarlet, shining seeds about the size of a pea, which after a while are suspended from the cone by means of a slender, elastic thread for some time before falling to the ground. All of the species of Magnolia here mentioned, and which belong to the magnolia family (Magnoliaceæ), bear these scarlet seeds, and the method of separating from the cone is the same. The soft heartwood is yellowish brown, while the sapwood is lighter.

FIG. 16.—Umbrella-tree (*Magnolia tripetala*), leaves.

Magnolia tripetala is a smaller tree, not exceeding 40 feet in height, also native; the smooth, gray, slender trunk measures from 4 to 18 inches in diameter. Its leaves are clustered at the ends of the flowering branches, and are from 12 to 18 inches long and about 4 to 8 inches wide, obovate, pointed at both ends, the upper surface dark green and smooth, the lower light green and more or less pubescent (fig. 16). The flowers are white, faintly odorous, produced in May, and are 7 to 8 inches in diameter, with 5 to 12 narrow, lance-shaped petals. The mature fruit cone is rose colored, conical, 4 to 6 inches long, and contains numerous scarlet seeds.

Magnolia glauca averages about 25 feet in height, with a smooth whitish gray trunk from a few inches to about a foot in diameter. The leaves, which are scattered along the flowering branches, are thick and leathery, smooth, dark green above, and on the lower surface pale green and glaucous or somewhat hairy (fig. 17). The solitary flowers are large, terminal, of a creamy white color, somewhat globular in shape, with obovate, rounded petals, and a very fragrant odor; they measure about 2 to 3 inches in diameter. The fruit cone is 1½ to 2 inches in height, oblong, and pink, with numerous scarlet seeds (fig. 17).

Description of bark.—Magnolia bark, as found in commerce, sometimes varies considerably, on account of the different species from which it is collected. They all possess similar properties, however, and the barks of the three species herein described were official from 1820 to 1890.

The last edition of the National Standard Dispensatory (1905) contains the following paragraph regarding the description of the bark:

"The commercial bark varies most widely, according to the species, the age, and the presence or absence of the corky layer, so that a general description is extremely difficult. The outer surface of old bark of all species is more or less ashy gray, due to the growth of lichens. When young, it is smooth or even glossy and of a brown color, varying more or less to orange or purplish red. With age it gradually becomes warty, the warts at length confluent into ridges and the ridges at length fissured. The inner surface is at first whitish, becoming gradually yellowish or pale brown, smooth, and very finely and closely striate, the striæ long and straight. When the bark has been deprived of the corky layer, the outer surface is almost exactly like the inner. In young bark, however, a green layer appears upon the removal of the cork. The fracture of the outer layer is smooth, short, and granular, of the inner more or less tough-fibrous. The transverse section is brownish and exhibits rather broad bast-wedges and medullary rays. The odor is slight, the taste warm, spicy, and somewhat astringent and, especially of the young bark, bitter."

FIG. 17.—Sweet bay (*Magnolia glauca*), leaves and fruiting cones.

Collection, prices, and uses.—The bark of the trunk or root is removed in spring and summer.

At present there does not seem to be much demand for magnolia bark. The price paid for the collection of the bark is about 3 cents a pound.

The bark is used for its tonic properties, for exciting perspiration, and in the treatment of fevers.

TULIP-POPLAR.

Liriodendron tulipifera L.

Other common names.—Liriodendron, tulip-tree, whitewood, canoewood, yellow poplar, blue poplar, hickory-poplar, lyre-tree, saddle-leaf, saddle-tree, cucumber-tree.

Habitat and range.—The tulip-poplar, which occurs in rich woods, attains its greatest size in the Middle and Southern States; its range extends from New England to Florida, westward to Michigan and Arkansas. It is also cultivated.

FIG. 18.—Tulip-poplar (*Liriodendron tulipifera*), trunk.

Description of tree.—This most handsome native forest tree, a member of the magnolia family (Magnoliaceæ), is readily distinguished by its somewhat peculiarly shaped leaves, and in spring by its greenish yellow tulip-shaped flowers. It attains great height, from 60 to 190 feet, and is very symmetrical in shape, with a straight, cylindrical trunk covered with grayish brown bark which in young trees is smooth, but becoming rough and fissured as the tree grows older (fig. 18). The leaves are smooth, generally rounded at the base, the top notched, or appearing as though cut straight across. They are roundish in outline or broadly oval, from 3 to 6 inches long, and have two to four lobes at the base and two at the top, the margins between the lobes rounded out, the base rounded or abruptly obtuse. (Fig. 19.)

The erect flowers appear in spring, and although they are quite large—about 2 inches long—they are not very conspicuous for the reason that their colors so blend with the yellow-green foliage of early spring that they pass almost unnoticed. On examining these flowers more closely they will be found to resemble tulips in form, with a very modest coloring, however, of green with a slight orange tinge toward the base of the petals, and the inside of the flower orange colored. The flowers have six petals and three reflexed petal-like sepals, and numerous stamens. The fruit ripens in the form of a dry, pointed cone, about 3 inches in length. (Fig. 19.)

FIG. 19.—Tulip-poplar (*Liriodendron tulipifera*), leaves, flowers, and fruit.

Description of bark.—The bark of both trunk and root, deprived of the outer layer, is used medicinally, and the tulip-poplar, or, as it is most frequently called in the drug trade, yellow poplar, or Liriodendron, was official in the United States Pharmacopœia from 1820 to 1880. It consists of slab-like pieces 3 or 4 inches long, very light, the outside as well as the inside of the inner bark yellowish white. When broken the fracture is ragged, splintery,

and uneven. There is a pronounced heavy, unpleasant odor, and the taste is aromatic, pungent, bitter, and somewhat astringent. The root bark is somewhat darker than that of the tree and is considered much more powerful.

Collection, prices, and uses.—In spring the bark is easily separated from the wood; the outer layer is shaved off, and the inner bark is then peeled in large slabs about 6 inches in width and from 3 to 6 feet in length. The root bark is collected in winter.

Collectors receive from about 1½ to 3 cents a pound.

The bark of the tulip-poplar is regarded as a bitter, stimulant tonic, and is considered useful in fevers, rheumatism, and digestive disorders.

SASSAFRAS.

Sassafras sassafras (L.) Karst.

Pharmacopœial name.—Sassafras.

Synonyms.—*Sassafras officinale* Nees & Eberm.; *Sassafras variifolium* (Salisb.) O. Kuntze.[a]

Other common names.—Ague-tree, saxifrax, cinnamonwood, saloop, smelling-stick.

Habitat and range.—Sassafras is a native tree, occurring in rich woods from Massachusetts to Ontario and Michigan, south to Florida and Texas.

Description of tree.—Sometimes the sassafras reaches almost 100 feet in height, its greatest height being attained in the South, but in the North it occurs principally as a shrub. The bark of old trees is rough and fissured, and of a grayish color, but the young twigs are smooth and green. The leaves are very variable in outline—some oval, some with three lobes, and some with but one lobe on the side, shaped like a mitten (fig. 20). The flowers are yellowish green and fragrant, and are borne in inconspicuous clusters, the staminate and pistillate on different trees; they appear in early spring, about the time that the leaves unfold. The fruit, which ripens about September, is oblong roundish, about the size of a pea, dark blue, one seeded, and borne on a thick, club-shaped red stalk (fig. 20). All parts of the tree are aromatic. It belongs to the laurel family (Lauraceæ). The wood is light, but strong and durable, whitish or with a reddish tinge, and also aromatic, except in the older trees.

FIG. 20.—Sassafras (*Sassafras sassafras*), leaves and fruits.

Description of bark.—The dried bark of the root of sassafras is official in the United States Pharmacopœia. As it occurs in the shops, it is in irregular curved pieces of varying length; smooth, the outer grayish layer having been removed; rusty red, soft, and breaking with a short, cork-like fracture. The inside of the bark is marked with short, indefinite lines. The odor is very aromatic, and the taste is sweetish, bitingly aromatic, and astringent.

[a] The pharmacopœial usage.

Collection, prices, and uses.—Sassafras bark is collected in early spring or autumn from the root, and the outer layer removed.

Sassafras bark is used for its tonic properties. It forms a popular domestic "spring medicine," and in early spring the market women display on their stands bundles of sassafras bark, to be made into a tea, by many people regarded as a useful remedy.

Sassafras oil, also official in the United States Pharmacopœia, is distilled especially from the root bark, but often also from the whole root. Maryland, Virginia, and Pennsylvania are the most important centers of production. It is used as an anodyne, also as a stimulant in neuralgia, and for the purpose of flavoring confectionery and soaps.

The dried pith (or medulla) from the branches is likewise official. It yields a mucilaginous liquid with water, and forms a soothing application for inflamed conditions.

The price paid to collectors may range from 2 to 10 cents a pound, according to quality.

SPICEBUSH.

Benzoin benzoin (L.) Coulter.

Synonyms.—*Laurus benzoin* L.; *Lindera benzoin* Meissn.; *Benzoin odoriferum* Nees.

Other common names.—Feverbush, Benjamin-bush, wild allspice, spicewood, snapwood.

Habitat and range.—This indigenous shrub frequents damp, shady woods and is seen along streams from Ontario south to North Carolina and Kansas.

FIG. 21.—Spicebush (*Benzoin benzoin*), leaves, flowers, and fruits.

Description of shrub.—The stemless clusters of yellow flowers of the spicebush appear very early in spring, about March or April, before the leaves. This shrub, a member of the laurel family (Lauraceæ), ranges from 4 to 20 feet in height, and has a smooth bark and slender green twigs. The leaves are oval, sharp pointed, 2 to 5 inches long, about half as wide and narrowing toward the base, lighter colored on the lower surface, and with margins entire. Some of the leaves are rounded at the top. The flowers are small, bright yellow, with a fragrant odor, and about four to six in a cluster, the staminate and pistillate flowers produced separately. The clusters of fruit ripen in autumn, and each bright red, obovate fruit contains one large white seed. (Fig. 21.)

Description of bark.—The thin quilled pieces of bark, as found in commerce, are dark brown on the outside, with small corky warts, and lighter brown and smooth on the inner surface. In older bark the corky excrescences will be found more prominent, and the color is also more ashen. The bark of the spicebush breaks with a short, granular fracture, has a faint, pleasant odor, and a warm, spicy, and astringent taste.

Collection, prices, and uses.—In the spring the bark can be readily removed in quills, and this is generally the time when it is gathered.

At present the price paid to collectors is about 3 cents a pound.

The bark is used as a remedy against worms and is also employed in the treatment of fevers.

The fruits are likewise employed in medicine.

WITCH-HAZEL.

Hamamelis virginiana L.

Pharmacopœial name.—Hamamelis.

Other common names.—Snapping hazel, winterbloom, wych-hazel, striped alder, spotted alder, tobacco-wood.

Habitat and range.—Witch-hazel is found in low damp woods from New Brunswick to Minnesota, south to Florida and Texas.

Description of shrub.—This indigenous shrub is one of our most peculiar plants, inasmuch as it begins to flower when all other trees and plants not only are through flowering, but generally have lost their foliage, namely, in November or even December. The seed is formed, but does not ripen until the following season. The peculiar, yellow, threadlike flowers among the usually bare branches at a season when most other vegetation is dead and the snow sometimes flies is a novel sight.

FIG. 22.—Witch-hazel (*Hamamelis virginiana*), leaves, flowers, and capsules.

Witch-hazel sometimes grows to about 25 feet in height, usually only 8 to 15 feet, with a crooked stem covered with smoothish brown bark, often with a growth of lichens, and having many long, forking branches. The leaves are 3 to 5 inches long, broadly oval or heart-shaped oval, with uneven sides, wavy margins and downy hairs when young, but becoming smooth as they grow older (fig. 22).

The flowers, as already stated, appear very late in autumn; they are bright yellow, and consist of a 4-parted corolla, with four long, narrow, strap-shaped petals, which are variously twisted when in full flower. The beaked, densely hairy seed capsule matures the following season, bursting open elastically, and scattering the large, black and shining, bonelike seeds for a distance of several feet. Thus, while the tree is in flower, there may be seen at the same time the mature seed capsules of the previous season. (Fig. 22.) This shrub belongs to the witch-hazel family (Hamamelidaceæ).

Description of bark.—Under witch-hazel or hamamelis bark, official in the United States Pharmacopœia, is understood the bark and twigs of the witch-hazel. The bark is found in commerce in the form of quills, varying in length and width, and is sometimes a purplish brown on the outside, sometimes a whitish or grayish brown color; occasionally it is smooth with a few warty

protuberances or numerous lenticels, and again it is furrowed and scaly, or even ragged. The inside is pale brown or yellowish, usually with long, straight lines. Sometimes fragments of the whitish wood are found adhering to the inner surface, and such bark should be discarded. Witch-hazel bark breaks with a weak fracture. There is a scarcely perceptible odor, and the taste is astringent and somewhat bitter.

The tough, flexible twigs do not exceed one-quarter of an inch in diameter, are branching, yellowish brown to a very dark or purplish brown, faintly wrinkled lengthwise, and with small, round, light-colored lenticels. There is a small central pith, and the bark which surrounds the greenish white wood occupies about one-fifth of the radius. If the twigs are more than a quarter of an inch in thickness, there will be too large a percentage of wood, which is inert.

Collection, prices, and uses.—The bark and twigs are the parts designated as official in the United States Pharmacopœia. In the United States Pharmacopœia, 1890, the leaves only were official. The witch-hazel industry is carried on to a considerable extent in portions of the New England States, the farmers bringing in to the distilleries cartloads of the brush. Witch-hazel bark brings about 1 to 4 cents a pound.

Witch-hazel is generally used for relieving inflammation of various kinds, and its soothing properties were known to the American Indians. The name "witch-hazel" is derived from the fact that formerly the forked branches were used as "divining rods," it having been the belief that these branches were endowed with a miraculous power of locating treasures, sources of water for wells, etc.

The leaves are still official in the United States Pharmacopœia.

BLACKBERRY.

(1) *Rubus villosus* Ait.; (2) *Rubus nigrobaccus* Bailey; (3) *Rubus cuneifolius* Pursh.

Pharmacopœial name.—Rubus.

Synonym.—(2) *Rubus villosus* A. Gray, *not* Ait.

Common names.—(1) American blackberry, bramble high-bush blackberry, one-flowered dewberry, fingerberry; (2) high-bush blackberry; (3) sand-blackberry, knee-high blackberry.

Habitat and range.—(1) The American blackberry is found in sandy or dry soil near the coast from Maine to South Carolina; (2) the high-bush blackberry occurs in dry fields and along roadsides from the New England States to Florida, west to Arkansas; and (3) the sand-blackberry frequents sandy soil from Connecticut to Florida, west to Missouri and Louisiana.

Descriptions of plants.—The blackberries are so well known that it is unnecessary to describe them. They are very similar to each other, differing principally in their habit of growth, the American blackberry being a trailing plant with slender branches, whereas the high-bush blackberry and sand-blackberry are more shrubby plants.

Other species.—Besides the blackberries just mentioned, and which are official in the United States Pharmacopœia, Eighth Revision, there are two others which were official in the United States Pharmacopœia for 1890, and which are still collected. These are the low-running blackberry (*Rubus procumbens* Muhl., syn., *R. canadensis* T. & G., *not* L.), and the low-bush blackberry or southern dewberry (*Rubus trivialis* Michx.), both being generally trailing plants. All are members of the rose family (Rosaceæ).

Description of bark.—The three species of blackberries mentioned as official have long, horizontal rootstocks covered with a thick bark, which is the part

used medicinally. In the stores it is found in long, quilled pieces, or in bands, tough and flexible, the outside a dark reddish brown or dark brownish gray, rather smooth or slightly scaly; inside pale brown, with long coarse grooves. It breaks with a tough, fibrous fracture, and has no odor, but an astringent, somewhat bitter taste.

Collection, prices, and uses.—The bark of the root is the part collected, and is stripped by making an incision lengthwise on one side of the root, after which it separates easily from the root, forming long quills.

At present the amount paid for the collection of blackberry bark ranges from 2 to 4 cents.

The blackberry barks possess tonic and astringent properties and form a popular remedy in the treatment of diarrheal complaints.

AMERICAN MOUNTAIN-ASH.

Sorbus americana Marsh.

Synonym.—*Pyrus americana* DC.

Other common names.—Roundwood, round-tree, American rowan-tree, American service-tree, mountain-sumac, dogberry, quick-beam, wild ash, wine-tree, witchwood, life-of-man, Indian mozemize, missey-moosey, moose-misse.

Habitat and range.—The American mountain-ash occurs in swamps, low woods, or moist ground from Newfoundland south along the mountains to North Carolina, and to Michigan. It is most abundant in the northern portion of its range.

FIG. 23.—American mountain-ash (*Sorbus americana*), leaves and fruits.

Description of tree.—This is a rather small, smooth-barked tree, very brilliant in fall and early winter with its clusters of bright red berries. Its greatest height is about 30 feet, with the trunk measuring about 18 inches in diameter, and covered with a smooth, dull brown or grayish bark. The leaves, resembling those of the sumac, consist of from 11 to 17 lance-shaped, long-pointed leaflets about 1½ to 4 inches long (fig. 23). When young they are somewhat hairy, both sides becoming smooth later, bright green on the upper surface, but usually lighter colored on the lower, the margins sharply toothed with short, stiff teeth. The white flowers are borne in dense clusters measuring 3 to 6 inches across, and have an urn-shaped calyx, 5 rounded petals, and numerous stamens. The American mountain-ash, which belongs to the apple family (Malaceæ), flowers about May or June, and is followed later in the season by large, dense, showy clusters of round, bright red berries, about the size of peas (fig. 23). It is indigenous to this country.

Description of bark.—As found in the stores, American mountain-ash bark consists of coarse pieces of varying length, about a quarter of an inch in thickness, with the outer layer removed; the outside is yellowish or pale brown, smoothish or sometimes with faint, lengthwise wrinkles, the inside smooth and brown. It is odorless, but the taste is bitter and astringent.

Prices and uses.—At present American mountain-ash bark brings from about 3 to 5 cents a pound. It is used for its tonic, astringent, and antiseptic properties.

FIG. 24.—Wild cherry (*Prunus serotina*), trunk.

WILD CHERRY.

Prunus serotina Ehrh.

Pharmacopœial name.—Prunus virginiana.

Synonym.—*Prunus virginiana* Mill., *not* of Linnæus.

Other common names.—Wild black cherry, cabinet-cherry, black choke, rum-cherry, whisky-cherry, Virginian prune-bark.

Habitat and range.—The wild cherry occurs in woods or open places, and is most abundant in the Southeastern States, but its range extends from Nova Scotia to Florida, westward to Texas, and north through Indian Territory, the eastern portions of Kansas, Nebraska, and South Dakota.

Description of tree.—The elongated, drooping, pretty clusters of white flowers of the wild cherry are usually produced in May. The tree sometimes reaches a height of 90 feet, and a maximum trunk diameter of 4 feet. The trunk is straight and covered with a rough black bark (fig. 24), the young branches, however, smooth and reddish. The reddish brown wood of the wild cherry is fine grained, hard and strong, susceptible of polish, and is used in cabinetmaking.

The leaves are thick and oval, about 2 to 5 inches long, smooth and shining, bright green above and somewhat hairy on the veins beneath, the margins furnished with callous teeth. The clusters of flowers borne at the ends of leafy branches are generally somewhat drooping, and consist of many small, white, 5-petaled flowers with numerous yellow stamens, the clusters of white against the green background making it a rather attractive tree. The cherries ripen about August or September, and are globular, black, or very dark purple, about the size of a pea, and have a sweet, somewhat astringent, and bitter taste. (Fig. 25.) The wild cherry, which is a native of this country, belongs to the plum family (Amygdalaceæ).

FIG. 25.—Wild cherry (*Prunus serotina*), leaves, flowers, and fruits.

Description of bark.—In commerce wild cherry bark is usually found in curved or irregular pieces, the outer surface smooth and somewhat shining, of a light green or brownish green color, and showing numerous transverse, light-colored lines or grooves, or "lenticels," as they are technically known. The inner surface is rust colored, marked with netlike grooves, or fissures. It breaks with a short, granular fracture. The taste is aromatic, astringent, and pleasantly bitter, reminding one somewhat of bitter almonds, as does the odor when the bark is soaked in water.

Collection, prices, and uses.—The bark, which is official in the United States Pharmacopœia, should be collected in autumn, as at that time it contains the greatest amount of hydrocyanic acid. The outside layer is removed, so that the green layer underneath shows, and the bark is then carefully dried and preserved. Wild cherry bark should not be kept longer than a year, as it deteriorates with age. The bark from very small or very old branches should not be used. Young, thin bark is considered superior.

The price to collectors at present ranges from 1 to 6 cents a pound, the highest amount being paid for the "thin green," the next best price for the "thick green," and the lowest for the "thick rossed."

Wild cherry bark is used for its tonic properties, and it also exerts a sedative action.

PRICKLY ASH.

(1) *Xanthoxylum americanum* Mill. and (2) *Xanthoxylum clava-herculis* L.

Pharmacopœial name.—Xanthoxylum.

Synonyms.—(1) *Xanthoxylum fraxineum* Willd.; (2) *Xanthoxylum carolinianum* Lam.; *Fagara clava-herculis* (L.) Small.[a]

Other common names.—(1) Northern prickly ash, toothache-tree, toothache-bush, yellowwood, angelica-tree, pellitory-bark, suterberry; (2) southern prickly ash, toothache-tree, Hercules-club, yellow Hercules, yellowthorn, yellowwood, yellow prickly ash, prickly yellowwood, West Indian yellowwood, sea-ash, pepperwood, wild orange.

Habitat and range.—The northern prickly ash is common in woods, thickets, and along river banks from Virginia, Missouri, and Nebraska northward to Canada, while the southern prickly ash grows along streams from southern Virginia to Florida, west to Texas and Arkansas. Both are indigenous to this country, and are members of the rue family (Rutaceæ).

Descriptions of trees.—The northern prickly ash (*Xanthoxylum americanum*) is smaller than the southern, usually 10 to 12 feet and rarely exceeding 25 feet in height, the branches having brown cone-shaped prickles. The leaflets in this species number from 5 to 11, and are ovate, practically stemless, 1½ to 2 inches long, somewhat pointed at the apex, and with margins wavy toothed or entire. When young the leaflets are somewhat hairy, but later they become smooth or retain only a slight hairiness, and are dark green on the upper surface and paler underneath. The greenish yellow flowers appear before the leaves, about April or May, but instead of being borne in terminal clusters, like those of the southern prickly ash, they are produced from the axils of the branches, many crowded together in small stemless clusters. The seed capsules, contain-

[a] The pharmacopœial usage.

ing one to two shining black seeds, are roundish or somewhat oval and greenish red, wrinkled and pitted, and have a lemon odor. The leaves and flowers are also aromatic.

Fig. 26.—Southern prickly ash (*Xanthoxylum clava-herculis*), trunk.

The southern prickly ash (*Xanthoxylum clava-herculis*), although generally a taller tree than the northern, does not attain great height, not exceeding 45 feet, and sometimes it is only a shrub. The trunk is covered with a slate-gray bark, and the entire tree is furnished with sharp spines, or prickles, those of the trunk smaller and borne on broad corky excrescences which remain after the spines have fallen away (fig. 26), while those of the branches and leaf stems are larger, but also have a broad base (fig. 27).

The leaves consist of 5 to 17 ovate lance-shaped leaflets 1½ to 3 inches long, with pointed apex and uneven sides, smooth and shining on the upper surface, dull beneath, and margins wavy toothed (fig. 27). After the leaves are out—about June—the numerous small greenish white flowers appear, borne in large clusters at the ends of the branches, and not in axillary clusters like those of the northern prickly ash. The seed capsules are roundish-obovoid, wrinkled, and contain roundish-oblong, black, and coarsely wrinkled seeds (fig. 27).

Description of bark.—The dried bark of both of these species is official in the United States Pharmacopœia under the general name Xanthoxylum. That of the northern prickly ash occurs in commerce in small curved or quilled pieces about 2 inches in length and sometimes nearly one-eighth of an inch thick, with a brownish gray, corky outside layer showing whitish patches and small black dots, slightly wrinkled, and a few shining, brown, straight spines, or prickles, about one-fourth of an inch in length and with a base about three-fourths of an inch long. The inner surface of northern prickly ash bark is smooth, whitish, or yellowish. It breaks with a short fracture, showing the green outer layer and the yellowish inner layer. The taste is very pungent and somewhat bitter, but there is no odor.

Fig. 27.—Southern prickly ash (*Xanthoxylum clava-herculis*), leaves, fruits, and branchlet showing prickles.

Southern prickly ash, as found in the trade, is in large sheets or quilled pieces, the outside a bluish gray or slate gray, with patches of silvery gray and numerous large corky excrescences sometimes with the large spines still attached. In other particulars it resembles the northern prickly ash.

Prices and uses.—The price paid to collectors ranges from about 4 to 9 cents a pound for the northern prickly ash and from 3 to 8 cents for the southern prickly ash.

Prickly ash bark has alterative, stimulant, and sialagogue properties, and is used in rheumatism and for increasing the secretions, for toothache, and externally as a counterirritant.

WAFER-ASH.

Ptelea trifoliata L.

Other common names.—Ptelea, wingseed, hop-tree, shrubby trefoil, swamp-dogwood, three-leaved hop-tree, ague-bark, prairie-grub, quinine-tree, stinking ash, stinking prairie-bush, sang-tree, pickaway-anise.

Habitat and range.—This indigenous shrub is found in shady woods from New York to Florida, west to Minnesota and Texas, occurring in greatest abundance west of the Alleghanies.

Description of shrub.—The wafer-ash, belonging to the rue family (Rutaceæ), is a shrub or small tree usually from 6 to 8 feet and not more than 20 feet in height, with leaves consisting of three oval leaflets 2 to 5 inches long, dark green and shining above, paler beneath, the margins slightly round toothed (fig. 28). The leaves are borne on long stems, but the leaflets are stemless. The flowers, which appear in June, are numerous in terminal compound clusters, greenish white, and have a disagreeable odor. The foliage also has an unpleasant odor. The flowers are followed by large clusters of winged fruits, each one containing two seeds. These fruits are flat, rounded in outline, the seeds surrounded by a membranous, veined wing (fig. 28). They have a bitter taste and have been used in place of hops. The wood of the wafer-ash is light brown.

FIG. 28.—Wafer-ash (*Ptelea trifoliata*), leaves and fruits.

Description of bark.—The dried bark of the root is the part employed in medicine, and as found in the stores it is in quilled pieces varying in length from one to several inches. The thin outer layer is pale brown and irregularly ridged and wrinkled. The inner surface is yellowish white, becoming darker with age. The bark, which is brittle, breaks with a smooth fracture, has a peculiar odor, and a bitter, pungent, and somewhat acrid taste.

Collection, prices, and uses.—The bark is taken from the roots. At present it brings collectors from about 4 to 8 cents a pound.

Wafer-ash bark possesses tonic properties, and is employed in fevers. It is also said to be useful as an anthelmintic.

BLACK ALDER.

Ilex verticillata (L.) A. Gray.

Synonym.—*Prinos verticillata* L.

Other common names.—Prinos, winterberry, common winterberry, Virginia winterberry, false alder, white alder, feverbush.

Habitat and range.—The black alder is native in swamps, moist woods, and along banks of streams, in Canada and the eastern United States, and westward to Wisconsin and Missouri.

Description of shrub.—The fruits of the black alder are a familiar sight in the Christmas markets, the bare branches with the persistent, shining, bright red berries being much used for decorative purposes during the holiday season. Black alder is a shrub usually from 6 to 8 feet high (sometimes 25 feet), with grayish bark and smooth twigs. The leaves are oval or oblong lanceolate, pointed at the apex, about 2 to 3 inches long, and about an inch in width. They are rather thick and leathery in texture, dark green and smoothish on the upper surface, hairy on the lower surface, especially along the veins, and sharply toothed. In autumn the leaves turn black.

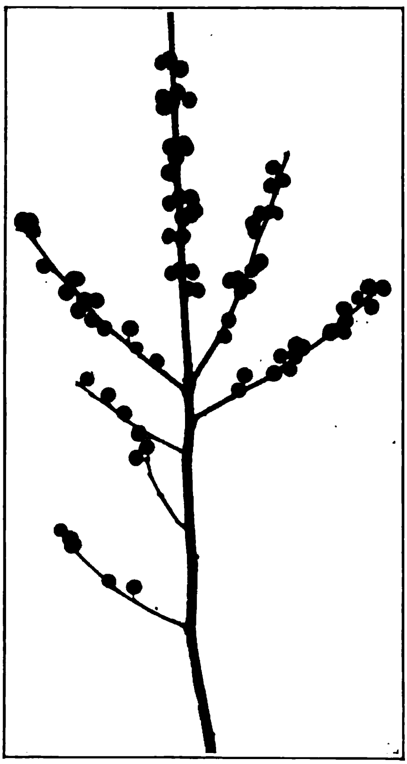

FIG. 29.—Black alder (*Ilex verticillata*), fruits.

The flowers, which appear from about May to July, are small and white, the male clusters consisting of 2 to 10 flowers, and the female of only 1 to 3. The fruits are bright red and shining, about the size of a pea, clustered around the stem, and each containing six seeds (fig. 29). Black alder belongs to the holly family (Aquifoliaceæ).

Description of bark.—The bark, which was official in the United States Pharmacopœia from 1820 to 1890, occurs in commerce in somewhat quilled strips or pieces of an ashy brown color outside, with whitish patches and round black spots and lines. The inner surface is greenish or yellowish, and marked with short lines. The fracture is short, showing a greenish tinge. It has a faint, peculiar odor and a bitter, astringent taste.

Collection, prices, and uses.—Black alder bark is collected in autumn. The amount paid to collectors ranges from 2 to about 5 cents a pound.

It is used in medicine as a tonic and astringent. The berries are employed for similar purposes as the bark.

WAHOO.

Euonymus atropurpureus Jacq.

Pharmacopœial name.—Euonymus.

Other common names.—Burning-bush, spindle-tree, Indian arrowwood, bursting-heart, strawberry-tree, strawberry-bush, American spindle-tree, bitter ash, pegwood.

Habitat and range.—Wahoo is found in woods and thickets from Ontario and the eastern United States west to Montana.

Description of shrub.—This native shrub or small tree is from 6 to 25 feet in height, more often reaching only 10 feet, with an ashy gray bark, twigs somewhat 4-angled, and leaves from 1½ to 5 inches in length and about half as wide, oval-oblong or elliptical, and long pointed at the apex (fig. 30). They are rather thin in texture, with a prominent midrib, more hairy on the lower surface than above, and the margins round toothed. The 4-petaled purple flowers are produced in June, in loose, slender-stemmed clusters of from 5 to 15 flowers each, and have 4 wavy, obovate petals. The pale purple fruits are rather odd looking, consisting of 4 deeply cleft, flattened lobes, smooth, each cell containing 1 or 2 seeds (fig. 30). These capsules open after they ripen, about October, and disclose the seed surrounded by a red aril (false coat enveloping the seed), the bush at this time presenting a very bright and showy appearance.

FIG. 30.—Wahoo (*Euonymus atropurpureus*), leaves and fruits.

The name "wahoo" is applied indiscriminately to *Euonymus atropurpureus* and *E. americanus*—the latter a low or trailing bush having crimson capsules, to which the appellation "burning-bush" more properly belongs. Both species, which are members of the staff-tree family (Celastraceæ), are used in medicine, although *E. atropurpureus* alone is recognized in the United States Pharmacopœia.

Description of bark.—The dried bark of the root of wahoo is official in the United States Pharmacopœia. It is in quilled pieces of irregular size. The outside of the bark is furrowed and ridged, of an ashy or light brownish gray color, showing a few dark patches of soft cork. The inner surface is smooth and whitish or somewhat pale brownish. The fracture is short, whitish, and shows fine silky fibers. There is a distinct odor, and the taste is sweetish, bitter, and somewhat acrid.

Collection, prices, and uses.—Although the bark from the stem is also sometimes gathered, it is the root bark only which is recognized as official.

The root bark at present brings from 9 to 20 cents a pound. It has tonic. diuretic, laxative, and antiperiodic properties; it acts on the liver, increasing the flow of bile, and is also employed in intermittent fevers and in dyspepsia.

FALSE BITTERSWEET.

Celastrus scandens L.

Other common names.—Climbing bittersweet, shrubby bittersweet, fevertwig, fever-twitch, staff-tree, climbing staff-tree, staff-vine, waxwork, Roxbury waxwork, yellowroot, climbing orange-root, Jacob's-ladder.

Habitat and range.—This woody vine or climbing shrub is found in woods and thickets, growing in rich damp soil, from Ontario to Manitoba, south to North Carolina and New Mexico.

Description of plant.—False bittersweet is a most attractive plant in the fall, with its brilliant orange-yellow and scarlet seed capsules adding a vivid dash of color to the fall and winter landscape, remaining on the vine well into the cold season.

FIG. 31.—False bittersweet (*Celastrus scandens*), leaves, flowers, and fruits.

It is an indigenous woody and shrubby climber, growing over adjacent trees or near-by fences. The leaves are thin and smooth, oval, 2 to 4 inches long, and about half as wide, pointed at the apex, and with a pointed or rounded base, the margins furnished with fine, rounded teeth. The small, greenish white or greenish yellow flowers are produced in June, in short terminal clusters, and the fruit is in the form of a roundish, 3-celled, orange-colored capsule, which opens in autumn, disclosing the scarlet-covered seed, making a very showy appearance. This covering is known as an "aril." (Fig. 31.)

False bittersweet and true bittersweet, on account of the similarity of the common names, are often confused, but the plants do not resemble each other at all, belonging to entirely different families and possessing different medicinal properties. False bittersweet belongs to the staff-tree family (Celastraceæ), while the true bittersweet is a member of the nightshade family (Solanaceæ).

Description of bark.—The bark of both plant and root is employed, but especially that of the root. The latter is rather smooth, in small quilled pieces, the outer surface covered with a thin, papery layer of dark orange-brown and the inner surface white and finely grooved. The bark from the stem has a brown-gray color. There is practically no odor, and the taste is bitter, becoming sweet, then somewhat acrid and rather sickening.

Prices and uses.—The price paid to collectors varies from 5 to 10 cents a pound.

The bark of false bittersweet possesses alterative, emetic, diaphoretic, and diuretic properties, and some narcotic action is also attributed to it.

HORSE-CHESTNUT.

Aesculus hippocastanum L

Other common names.—Hippocastanum, bongay, konker-tree.

Habitat and range.—This handsome tree is a native of Asia, largely cultivated in this country as an ornamental shade tree. In parts of New York and New Jersey it has escaped from cultivation.

Description of tree.—The horse-chestnut is a rather large tree, usually about 40 feet in height, and having many branches. Sometimes it will grow as tall as 100 feet. The bark has a brownish gray color, smoothish on the younger trees, but fissured and scaly on the older ones (fig. 32). The large, shining, resinous leaf buds are a prominent feature of the winter and early spring aspect of the tree. The leaves when mature are smooth, except perhaps for tufts of hairs on the veins of the lower surface, but the young unfolding leaf is quite hairy. The leaves are large, composed of 5 to 7 leaflets 4 to 8 inches long, pointed and broadest at the top and narrowing toward the base, with irregularly round-toothed margins (fig. 33).

FIG. 32.—Horse-chestnut (*Aesculus hippocastanum*), trunk.

FIG. 33.—Horse-chestnut (*Aesculus hippocastanum*), leaves and fruits.

The flower cluster, sometimes 1 foot in length, is most handsome and showy in appearance, consisting of a dense, somewhat pyramidal head of large white flowers, the petals fringed, wavy, and spotted with yellow and red, and having protruding stamens. They appear about June. The fruit is roundish and prickly, about an inch or so in diameter, and contains a large, shining brown nut (fig. 33). This tree belongs to the buckeye family (Aesculaceæ).

Other species.—The Ohio buckeye (*Aesculus glabra* Willd.), called also smooth buckeye and fetid buckeye, occurs in woods and along river banks from Pennsylvania south to Alabama, and westward to Michigan and the Indian Territory. It is a small tree, native in

this country, and found in great abundance in Ohio. It gives off a fetid odor, and has leaves consisting of five ovate leaflets, and small insignificant yellow flowers. The bark and nut of this species are also employed in medicine, having properties similar to those of the horse-chestnut, but it is said that their action is more powerful.

Description of bark.—The horse-chestnut bark of commerce is thin, brownish gray on the outside, and with a few warty protuberances, leafscars, and lichens; the inside of the bark is smooth and whitish, and the whole breaks with a tough, fibrous fracture, showing a brownish color within. The bark has a faint, disagreeable odor, and a rough, bitter, astringent taste.

Collection, prices, and uses.—Horse-chestnut bark is collected in the autumn, and preference is given to the bark from the younger branches. From 1 to 4 cents a pound is the price paid to collectors.

This bark is used for its "tonic, astringent, febrifuge, narcotic, and antiseptic" properties. The nuts are said to have a narcotic action, and when powdered, excite sneezing.

The leaves are an old remedy in the treatment of whooping cough.

FIG. 34.—Cascara sagrada (*Rhamnus purshiana*), five-year-old tree.

CASCARA SAGRADA.

***Rhamnus purshiana* DC.**

Pharmacopœial name.—Rhamnus purshiana.

Other common names.—Chittem-bark, sacred bark (a translation of the Spanish name "cascara sagrada"), bearberry-tree, bearwood, shittim-wood, Purshiana bark, Persiana bark.

Habitat and range.—This indigenous tree occurs on the sides and bottoms of canyons from the Rocky Mountains to the Pacific Ocean, extending north into British America.

Description of tree.—The tree furnishing the cascara sagrada of the Pharmacopœia is of small size, usually from 15 to 20 feet in height (fig. 34), the young twigs hairy, and the leaves rather thin. It belongs to the buckthorn family (Rhamnaceæ). The dark green leaves are elliptical in form, from 2 to 6 inches long, and about 1 to 3 inches wide, blunt at the apex or with a short sharp point, finely saw toothed, rounded or slightly heart shaped at the base, somewhat hairy on the lower surface, and rather prominently veined (fig. 35).

The rather small, insignificant greenish flowers are produced in umbels, or clusters, and are followed by black, ovoid, 3-seeded berries, of a somewhat insipid taste (fig. 35).

Another species.—Several species of Rhamnus occur in the cascara district, only one of which, however, may be said to enter into competition with the official cascara, and that is the one which is supposed to have been first introduced in medicine. It is known as wild coffee or coffee-berry (*Rhamnus californica* Esch.). At the present time, however, it is seldom collected, and then only because it may be mistaken by collectors for the official bark. According to the nineteenth edition of the United States Dispensatory (1907), *R. californica* "is chiefly distinguished from the official species by its leaves being thin, and when not smooth having a short close pubescence, and the primary veins of the under surface not nearly so numerous, straight, or fine as those of *R. purshiana.*" *Rhamnus purshiana* is abundant in the northern part of California and only sparingly found in the southern portion, whereas exactly the opposite is true of *R. californica.* Professor Rusby (United States Dispensatory, nineteenth edition, 1907) is of the opinion that as a further distinguishing mark in the leaves the channel of the midrib of *R. californica* is "altogether absent, or shallow, or inconspicuous."

FIG. 35.—Cascara sagrada (*Rhamnus purshiana*), leaves and fruits.

It is very difficult to distinguish the barks of these two species by their gross characters alone, but a microscopical examination will show structural differences sufficiently distinct to aid in the recognition of the barks.[a] In the powdered state the two species may be distinguished by means of color tests.[b]

Description of bark.—The cascara sagrada of commerce occurs in curved or quilled pieces, the outer surface of which is reddish brown, and usually covered with growths of light-colored or grayish lichen, wrinkled and somewhat fissured. The inner surface of the bark is smooth and marked with very fine lines; at first the inside is yellowish, but with age it turns a dark brown color. The whole breaks with a short, sharp, yellowish fracture, and has a somewhat aromatic odor and an exceedingly bitter taste. The saliva is colored yellow by it, and anything with which the bark comes in contact for any length of time will also be stained yellow. Cascara sagrada is official in the United States Pharmacopœia.

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[a] Rusby, H. H. Cascara Sagrada and Its Allies. Proc. Amer. Pharm. Assoc., 1890, pp. 203–211.

[b] Sayre, L. E. Frangula and Cascara Barks. Amer. Jour. Pharm., 1897, pp. 126–134.

Collection, prices, and uses.—The collecting season for cascara opens about the end of May or early in June and closes about the end of August, just before the rainy season sets in, as bark collected after exposure to wet weather is difficult to cure properly.

After the strips of bark have been removed from the trees, they are generally strung on wires to dry, care being taken not to expose the inner surface to the sun, the object being to retain the yellow color, as the action of the sunlight tends to darken the color, an undesirable result, inasmuch as it lowers the market price. During the drying process the strips curl up, forming quills, and when sufficiently dried these are cut or broken up into smaller pieces.

Several years are generally required after collection to properly age the bark for medicinal purposes, and the United States Pharmacopœia directs that it should not be used until at least one year after it has been gathered. Some crude-drug dealers undertake the "aging" of the bark themselves rather than leave it to collectors.

Many trees are annually destroyed in the collection of cascara sagrada, as they are usually peeled to such an extent that no new bark is formed. It has been estimated that one tree furnishes approximately 10 pounds of bark, and granting a crop of 1,000,000 pounds a year, 100,000 trees are thus annually destroyed, and the world's consumption is said to be about 2,000,000 pounds a year.

The price at present paid to collectors for cascara sagrada varies from 3 to 4½ cents a pound. On account of the fact that cascara sagrada requires several years' aging before use, a shortage in the crop is not immediately felt.

Cascara sagrada is a most valuable laxative, differing from other drugs of this character in that it tones up the entire intestinal tract, making long-continued dosing or gradually increasing dosage unnecessary.

COTTON.

Gossypium hirsutum L. ("*Gossypium herbaceum* L.")

Species.—According to the United States Pharmacopœia, cotton-root bark is obtained from "*Gossypium herbaceum* Linne," or from "other cultivated species of Gossypium."

For years the name *Gossypium herbaceum* has been used in botanical and other works as applying to American cotton, whereas it is really a name belonging to an Old World species, known as Levant cotton, cultivated in India and also in southern Europe, and it is stated that the American species evidently received the appellation *herbaceum* as a result of wrong identification by early American authors, and the assumption that it originated from European seed.[a]

American Upland cotton is the type most commonly cultivated in the South, from Virginia to Oklahoma and Texas, and this with its hundred or more recognized horticultural varieties all belong to one species, namely, *Gossypium hirsutum* L.,[b] and not to *G. herbaceum*, and as practically all of the supply of cotton-root bark of the United States is obtained in the United States, it can safely be asserted that *Gossypium hirsutum* L., and not *G. herbaceum* L., is the principal source of the bark found in the commerce of our country.

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[a] Dewey, L. H. The Identity of American Upland Cotton. Science, n. s., vol. 19, p. 337. 1904.

[b] Dewey, L. H. Principal Commercial Plant Fibers. Yearbook, U. S. Dept. of Agriculture, 1903, p. 388.

Description of plant.—The cotton plant in flower or with the bursting bolls showing the fluffy white fiber is very handsome. It belongs to the mallow family (Malvaceæ), and ranges from about 1 to 4 feet in height, with a woody and somewhat branching stem. The leaves of the American Upland cotton, *Gossypium hirsutum*, are 5 lobed, the lobes sharply pointed. The flowers when they first open are creamy white, later on turning purple, and the bracts are deeply cleft. The 4 to 5 celled cotton bolls are roundish oval, bluntly pointed at the top, green at first, but turning brown as they mature, bursting open (September to November in the Southern States), and disclosing the fine fiber that surrounds and completely hides the seeds, and which forms the "cotton" of commerce. (Fig. 36.) This cotton is picked from the bolls by hand, and sent to the cotton gins, where the seed is separated from the lint by machines known by that name. The seed, aside from its use for planting, is employed for fertilizing and feeding purposes, and an oil is also expressed therefrom.

FIG. 36.—Cotton (*Gossypium hirsutum*), leaves, flowers, and bolls.

Description of bark.—Cottonroot bark is official in the United States Pharmacopœia, and the article of commerce consists of long, thin bands, or quills, flexible, of a brownish yellow color on the outside, showing faint ridges and dots or lines. Sometimes the entire outer corky layer, which is thin, is wanting, or there are brownish orange patches where this thin layer has rubbed off or worn away. The inner surface of the bark has a whitish, silky, shining appearance, marked with fine lines. The long, tough bast fibers separate into papery layers. There is no odor, but a faintly acrid and astringent taste.

Collection, prices, and uses.—The roots are taken up as late as November or December, but before frost, washed, the bark removed with knives, and carefully dried. The fresh bark is regarded as more reliable than the old bark.

At present cottonroot bark is paid for at the rate of from 3 to 5 cents a pound.

This bark, with its emmenagogue and parturifacient properties, forms a valuable remedy in the hands of the physician.

The cotton (the hairs of the seed), freed from impurities and deprived of all fatty matter, is also official in the United States Pharmacopœia.

An oil is expressed from the seed, and various domestic uses have been made of the seed and also of the flowers and leaves.

DOGWOOD.

Cornus florida L.

Other common names.—Cornus, flowering dogwood, American dogwood, Virginia dogwood, Florida dogwood, boxwood, New England boxwood, false boxwood, American cornelian tree, flowering cornel, Florida cornel, white cornel, Indian arrowwood, nature's-mistake.

Habitat and range.—Dogwood, native in this country, occurs in woods from Massachusetts and southern Ontario to Florida, Texas, and Missouri, but grows most abundantly in the Middle States.

FIG. 37.—Dogwood (*Cornus florida*), trunk.

Description of tree.—The dogwood, which belongs to the dogwood family (Cornaceæ), is never a large tree, its greatest height being 40 feet, and more frequently it occurs as a shrub. It is one of the most conspicuous trees in early spring, the naked, leafless branches supporting numerous large, showy white flowers, so called. The white, petal-like parts, however, which are the most showy portions, are in reality "bracts," the "flowers" themselves being greenish yellow and inconspicuous, except for these four surrounding bracts. The four bracts, or petal-like parts, are white, sometimes pink tinged, of an inverted oval or heart shape, with prominent parallel veins, and peculiarly notched at the end, as though a piece had been torn or bitten out. (Fig. 38.)

After the flowers have disappeared the leaves are put forth. These are generally oval, entire, from 3 to 6 inches in length, the upper surface dark green and smooth or only minutely hairy, while the under surface is lighter in color with slightly hairy veins. The leaves turn a bright red in autumn and with the scarlet fruit, or berries, form a very showy and attractive addition to the autumnal woods. (Fig. 38.)

FIG. 38.—Dogwood (*Cornus florida*), leaves, flowers, and fruits.

The trunk of the dogwood is covered with a grayish brown, rough, and fissured bark (fig. 37), and the brown wood is hard and close grained.

Description of bark.—The root bark as found in the stores has had the fissured grayish brown outside layer removed and consists of short, reddish brown, curved pieces or chips about one-eighth of an inch in thickness. The inside is of a reddish purple color, with many short, broad grooves. The fracture is short. It has an astringent, bitter taste, but practically no odor.

Collection, prices, and uses.—Dogwood bark is collected from the root in the fall. It brings from 1 to 3 cents a pound.

It is used in medicine for its astringent, tonic, stimulant, and febrifuge properties and in the fresh state is said to be emetic. The root bark was official

in the Pharmacopœia from 1830 to 1890. During the Revolutionary war it was much employed as a substitute for Peruvian bark or cinchona.

The flowers and fruits have properties similar to those of the bark.

Other species.—The bark of the swamp-dogwood (*Cornus amomum* Mill., syn., *C. sericea* L.), and the round-leaved dogwood (*C. circinata* L'Her.) are also used, being sometimes substituted for the flowering dogwood.

The swamp-dogwood, known also as red osier, silky cornel, rose-willow, blue-berried cornel, kinnikinnick, female dogwood, red-brush, red-rod, red willow, and squawbush, is a shrub native in low woods and along streams from Canada to Florida, west to Texas and the Dakotas.

The bark of this species, which was official from 1820 to 1880, is used like the flowering dogwood bark, but is said to be less bitter and astringent. It occurs in thin, quilled pieces, of a purplish brown color on the outside, with fewer warty excrescences than the following species, but otherwise similar. The price paid for this bark ranges from 4 to 6 cents a pound.

The round-leaved dogwood or cornel, called also green osier, is an indigenous shrub growing in shady places in Canada and the northeastern United States.

This bark is also used like that of the flowering dogwood, and was official from 1820 to 1880. It is said to possess less astringency than the flowering dogwood, but is more bitter. In commerce it is found in quilled or curved pieces, of a brownish gray or greenish color outside, with corky warts or marked with lengthwise lines, the inside brown. This also brings from about 4 to 6 cents a pound.

MOOSEWOOD.

Dirca palustris L.

FIG. 39.—Moosewood (*Dirca palustris*), leaves and flowers. (From Edwards's Botanical Register.)

Other common names.—Dirca, American mezereon, leatherwood, leather-bush, leverwood, leaverwood, rope-bark, swampwood, wickopy, wickup.

Habitat and range.—This native shrub is found in wet woods and thickets from New Brunswick to Florida, west to Missouri and Minnesota, but is most common in the Northern and Eastern States.

Description of shrub.—The moosewood, a shrub belonging to the mezereon family (Daphnaceæ), is from 2 to about 6 feet in height, with tough, fibrous bark, and smooth, yellowish green twigs. The leaves, which are hairy when young, are oval with a blunt apex, rounded or narrowed at the base; they become smoother as they mature, and are from 2 to 3 inches long. The flower clusters are produced from April to May, from brown-hairy, scaly buds and consist of 2 to 4 yellowish, funnel-shaped flowers about one-half inch in length, with stamens and style protruding. (Fig. 39.) The one-seeded fruit, or berry, is small, red, oval oblong, and poisonous.

Description of bark.—Moosewood bark occurs in long, stringy, or quilled pieces, light brown or grayish brown on the outside, slightly wrinkled lengthwise, marked here and there with warty excrescences and an occasional patch of lichen growth, the inside straw colored and smooth. The bark is exceedingly tough and fibrous, and can not be broken. The odor is rather strong and aromatic, and the taste pungent and acrid.

FIG. 40.—White ash (*Fraxinus americana*), trunk.

Prices and uses.—Moosewood bark brings from 5 to 10 cents a pound.

It has emetic and laxative properties, and in decoction is used as a sudorific and expectorant. The fresh bark applied externally is very irritating to the skin, causing redness and blisters.

WHITE ASH.

Fraxinus americana L.

Synonyms.—*Fraxinus alba* Marsh; *Fraxinus acuminata* Lam.

Other common names.—Ash, American white ash, cane-ash.

Habitat and range.—The white ash is native in rich woods, occurring from Nova Scotia to Minnesota, south to Florida and Texas, but chiefly in the Northern States and Canada.

Description of tree.—This tree, a member of the olive family (Oleaceæ), sometimes attains a height of 120 feet or so, usually, however, from 60 to 80 feet, the older trees with gray, deeply furrowed bark (fig. 40), and smooth, greenish gray branches. The leaf buds are rust colored, and the white ash is one of the latest trees to put out leaves in the spring. The leaves measure about 12 inches in length and consist of 5 to 9 leaflets; these are oval or lance-shaped oblong, the margins entire, the apex pointed, dark green above and pale green or silvery beneath, or sometimes hairy, 3 to 5 inches long, and somewhat less than half as wide (fig. 41). In autumn they change to yellow, mottled with green, and finally turn black. The small, whitish green flowers are arranged in loose clusters, appearing from about April to June, and the fruits which follow are in the form of clustered winged seeds, or "samaras" (fig. 41), which remain on the branches for a long time. Each samara is from

FIG. 41.—White ash (*Fraxinus americana*), leaves and fruits.

1 to 2 inches long, narrow, flat, and one seeded. The wood of white ash is brown, hard, and strong.

Description of bark.—The bark of white ash, as found in the stores, is whitish or inclined to yellowish brown, about one-fourth of an inch thick or less, the outside corky layer generally having been removed, but pieces of it often adhering. The inner surface is smooth and yellow. The fracture is very fibrous. White-ash bark has a faint aromatic odor and a bitter, acrid taste.

Collection, prices, and uses.—The bark of the root is preferred, although that from the trunk is also collected; the outer layer is usually removed. The amount at present paid for white-ash bark ranges from 3 to 5 cents a pound.

White-ash bark has been employed as an antiperiodic in intermittent fever, and is said to possess tonic and astringent properties. The leaves in infusion have been used in the treatment of gout and rheumatism.

Another species.—The black ash (*Fraxinus nigra* Marsh, syn., *Fraxinus sambucifolia* Lam.) is also a native, inhabiting swamps and wet woods from Canada to Virginia and Arkansas. Other names applied to it are hoop-ash, swamp-ash, water-ash, and basket-ash. Its maximum height is 100 feet, and its bark is darker gray and less fissured than that of the white ash, and its leaves are darker green. The leaves are about 16 inches in length, the 7 to 11 stemless leaflets perhaps a trifle paler green on the lower surface than above, and with rust-colored hairs on the midrib and veins of the lower surface. These leaflets are 3 to 6 inches long, narrow, oblong lance shaped, with long-pointed apex, the margins sharply toothed. The flowers appear from about April to May, and are followed by clusters of winged seeds, each flat, winged, linear-oblong fruit measuring from 1 to 1½ inches in length, narrow, with the winged portion extending all around the seed.

The bark, and also the leaves, are employed in medicine for similar purposes as those of the white ash. The bark brings about 3 to 5 cents a pound.

FIG. 42.—Fringe-tree (*Chionanthus virginica*), leaves and flowers.

FRINGE-TREE.

Chionanthus virginica L.

Other common names.—American fringe-tree, white fringe, flowering ash, poison-ash, graybeard-tree, old-man's-beard, shavings, snowdrop-tree, snow-flower.

Habitat and range.—The fringe-tree is native in moist thickets and along streams from Delaware to Florida and Texas.

Description of shrub.—When in full flower this shrub or small tree, with its dense clusters of white, fringelike flowers, is very attractive, and is often cultivated for ornament. It is a member of the olive family (Oleaceæ), and is from 6 to 20 feet in height, the trunk covered with a light-colored bark, the

leaves oval or oblong, of a leathery texture, and smooth. The flowers, which from their drooping character give a fringelike appearance, are produced in May and June, and are borne in dense clusters, each flower having four very narrow white petals about an inch in length. (Fig. 42.) The fruits which follow are fleshy, oval, and bluish black, containing a one-seeded nut.

Description of bark.—The bark of the root is the part employed in medicine, and it is in quilled or curved pieces of unequal size and shape, rather thick, the outside of a yellowish brown color, somewhat wrinkled, the inside yellowish brown or dark brown, marked with lengthwise lines. It breaks with a short, smooth fracture, and has but a faint odor.

Prices and uses.—At present collectors are paid from about 5 to 8 cents a pound.

It possesses tonic, febrifuge, and laxative properties, and is also said to have a narcotic action.

BITTERSWEET.

Solanum dulcamara L.

Other common names.—Dulcamara, nightshade, climbing nightshade, woody nightshade, amara-dulcis, fevertwig, violet-bloom, blue bindweed, felonwort, poison-berry, poison-flower, pushion-berry, morrel, snakeberry, wolf-grape, scarlet-berry, tether-devil, dwale, skawcoo.

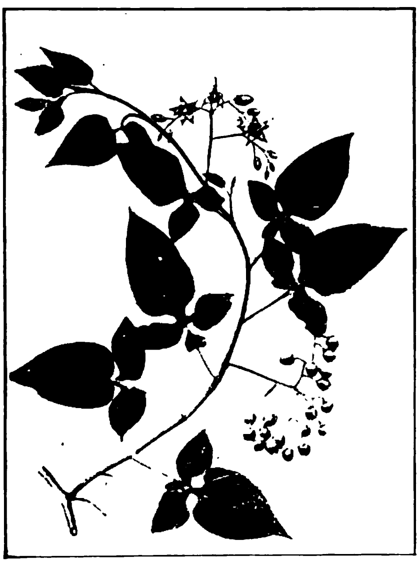

Fig. 43.—Bittersweet (*Solanum dulcamara*), leaves, flowers, and fruits.

Habitat and range.—Bittersweet has been naturalized from Europe, and occurs in low, damp grounds and moist banks of rivers from New Brunswick to Minnesota, south to New Jersey and Kansas.

Description of plant.—This climbing, shrubby perennial is often planted as an ornamental, and with its clusters of pretty purplish flowers and branches of berries ranging in color from green to yellow and orange, and finally red, occurring on the vine together, it makes a rather attractive showing. Bittersweet has a climbing, somewhat woody, branched stem, about 2 to 8 feet long, and oval leaves 2 to 4 inches long, pointed at the apex, and somewhat heart shaped at the base. Some of the leaves have one lobe at the base, some three lobes, while others are entire. The purplish flowers, resembling those of the potato (to which family, Solanaceæ, this plant belongs), are produced from about May to September, borne in compound lateral clusters. The fruits, or berries, which ripen in autumn, are oval, red, and juicy, and contain numerous whitish seeds. (Fig. 43.) The berries look very tempting, but they are poisonous, and children have been known to be poisoned by eating them.

Description of medicinal part.—The young branches of bittersweet are the parts employed in medicine, and were official in the United States Pharma-

copœia for 1890. As found in commerce, they consist of cylindrical pieces of varying length and of not more than about one-fifth of an inch in thickness, with a greenish gray thin bark, marked with lengthwise lines. The woody portion is light, and the center is sometimes hollow, and sometimes shows a spongy pith. There is but a faint, somewhat narcotic odor, and the taste at first is bitter, then sweet—"bittersweet."

Collection, prices, and uses.—Bittersweet branches are collected when they are only one or two years old and at a time when the leaves have fallen. The price paid ranges from 3 to 5 cents a pound.

Bittersweet is used for its diuretic and diaphoretic properties, and, according to the dose employed, has a quieting, hypnotic influence.

BUTTONBUSH.

Cephalanthus occidentalis L.

Other common names.—Buttonwood, buttonwood-shrub, button-tree, swamp-dogwood, pond-dogwood, swampwood, river-bush, honey-ball, pinball, whiteball, little snowball, globeflower, mountain-globeflower, crane-willow, wild licorice, crouper-bush.

Fig. 44.—Buttonbush (*Cephalanthus occidentalis*), leaves and flowers.

Habitat and range.—The buttonbush is indigenous to this country, and flourishes in swamps or damp places from southern Canada to Florida and California.

Description of shrub.—This is usually a widely spreading shrub from 3 to 12 feet in height or occasionally a small tree, with large, shining, dark green leaves, and producing from June to September round heads of creamy white flowers, the protruding, thread-like styles with the small, knoblike stigmas giving them the appearance of inserted pins, whence the name "pinball." The stems are covered with a rough yellowish bark, while the smaller branches are smooth and tinged with red. Some of the leaves are opposite, others ternate—that is, arranged in threes—and are ovate or ovate lance shaped, pointed, smooth, and glossy, with unbroken margins, and from 3 to 5 inches long. The flower heads, about 1 inch in diameter, consist of numerous creamy white, stemless flowers, densely crowded together in globular form, each flower having a funnel-shaped corolla with 4-toothed margin, from which the slender style with its globular stigma protrudes. (Fig. 44.) The small dry fruit is inversely pear shaped, splitting open into two to four cells, each containing one seed. The buttonbush belongs to the madder family (Rubiaceæ).

Description of bark.—The bark occurs commercially in small, curved pieces, smooth and grayish brown and marked with fine lines if taken from young trees, furrowed and scaly and of a dull gray color if collected from older trees. The inner root bark, which is also used, occurs in shorter pieces, and is of a reddish brown color. The inner surface of the bark is whitish and smooth,

becoming a pale rust color when it is no longer fresh. It breaks with a tough, fibrous fracture, and has no odor, but a bitter and somewhat astringent taste.

Collection, prices, and uses.—The bark is collected from both stem and root. It brings about 7 cents a pound, but at present there seems to be no very great demand for it.

Buttonbush bark is used in fevers, and the inner bark is employed in coughs and as a diuretic.

CRAMP-BARK TREE.

Viburnum opulus L.

Pharmacopœial name.—Viburnum opulus.

Other common names.—Cranberry-tree, high-bush cranberry, wild guelder-rose, gueldres-rose, cherry-wood, dog rowan-tree, whitten-tree, red elder, rose-elder, marsh-elder, water-elder, white elder, gadrise, gaiter-tree, gatten, love-rose, May-rose, pincushion-tree, squawbush, witch-hobble, witch-hopple.

Habitat and range.—This native shrub occurs in low rich woods and borders of fields from New Jersey, Michigan, and Oregon, northward.

Description of shrub.—The whitish flower heads of this species are borne on stems about 1 inch in length, and measure from 3 to 4 inches across; the flowers on the outside are large, sometimes an inch in diameter, and sterile (without stamens or pistils), while those on the inside of the flower cluster are considerably smaller and fertile. The cultivated variety of this species, the well-known ornamental "snowball" of the gardens, has all of its flowers sterile.

The cramp-bark tree grows from 8 to 10 feet high, with branches generally erect and smooth, and broadly oval, 3-lobed leaves. The leaves are usually smooth on the upper surface, but with the veins on the lower surface somewhat hairy, and the margins coarsely toothed. The showy white flower clusters appear about June. The red fruits, which ripen rather late in the season and remain on the bush for some time, are roundish or oval, sour, and contain a round, flat stone. As may be inferred from some of the common names applied to this shrub, the fruit in taste and appearance bears some resemblance to the cranberry. The cramp-bark tree is a member of the honeysuckle family (Caprifoliaceæ).

Description of bark.—Cramp bark, official in the United States Pharmacopœia under the name "Viburnum opulus," is in transversely curved pieces, sometimes quilled, one-sixteenth of an inch or less in thickness, the outside grayish brown surface marked with lengthwise wrinkles and brown lenticels, and the inside pale brown, showing lengthwise lines. It breaks with a tough, fibrous fracture. There is practically no odor, and the taste is astringent and bitter.

Collection, prices, and uses.—Cramp bark is collected in the fall, and at present is paid for at the rate of about 2 to 4½ cents a pound.

Cramp bark, as this name indicates, is of use as an antispasmodic, and is also said to possess nervine, tonic, and astringent properties.

BLACK HAW.

Viburnum prunifolium L.

Pharmacopœial name.—Viburnum prunifolium.

Other common names.—Sloe, sloe-leaved viburnum, stagbush.

Habitat and range.—The black haw occurs in dry woods and thickets and on rocky hillsides from Connecticut to Florida, west to Michigan and Texas, but is found in greatest abundance in the South. It is indigenous to this country.

Description of shrub.—This shrub or small tree, from 10 to about 20 feet in height, has rather stout, spreading branches. The winter buds are small, short pointed, smooth, or sometimes with reddish hairs. Black haw has broadly oval or roundish-oval leaves, blunt or somewhat pointed at the top, 1 to 3 inches long, with a narrow or rounded base; they are nearly smooth, bright green, and have a finely toothed margin. The numerous stemless flower clusters are from 2 to 4 inches broad, composed of numerous white flowers appearing from April to June. The fruit, which is sweet and edible, is oval or somewhat roundish, about half an inch long, bluish black, covered with a bloom, and ripens in early autumn. It contains a somewhat flattened stone. (Fig. 45.)

Description of bark.—The bark of the stem was formerly official, but now the dried bark of the root is the part prescribed by the United States Pharmacopœia, Eighth Decennial Revision. It is in irregular or quilled pieces, of a dull brown color on the outer surface, somewhat scaly and with shallow furrows; the inner surface reddish brown, and the whole breaking with a weak, short, uneven fracture. There is a faint peculiar odor, and a very bitter, somewhat astringent taste.

FIG. 45.—Black haw and nanny-berry (*Viburnum prunifolium* and *V. lentago*), leaves and flowers.

Collection, prices, and uses.—Black haw bark is collected in autumn. The present prices to collectors are from 3 to 8 cents a pound.

This bark has nervine, antispasmodic, tonic, and diuretic properties.

Another species.—The sweet viburnum (*Viburnum lentago* L.), known also as nanny-berry and sheepberry, is a species which is collected with *prunifolium*, and, with it, considered official. It grows in rich soil from Canada south to Georgia and Kansas.

Sweet viburnum is an indigenous shrub or small tree, sometimes as tall as 30 feet, and somewhat resembling *prunifolium*. The winter buds, however, are longer pointed and smooth, the leaves have longer slender stems and are oval, long pointed at the apex, and generally rounded at the base. They are from 2 to 4 inches long, smooth on both surfaces, and sharply toothed. The stemless flower clusters, 2 to 5 inches broad, appear about May, followed by the oval, bluish black, bloom-covered fruit, which matures about October, becoming sweet and edible. (Fig. 45.) The fruit sometimes remains on the shrub until the following spring. It contains a very flat, round or oval seed. Like the cramp-bark tree, the black haw and sweet viburnum both belong to the honeysuckle family (Caprifoliaceæ).

The bark of the sweet viburnum is also collected in autumn, and is used like *prunifolium*.

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